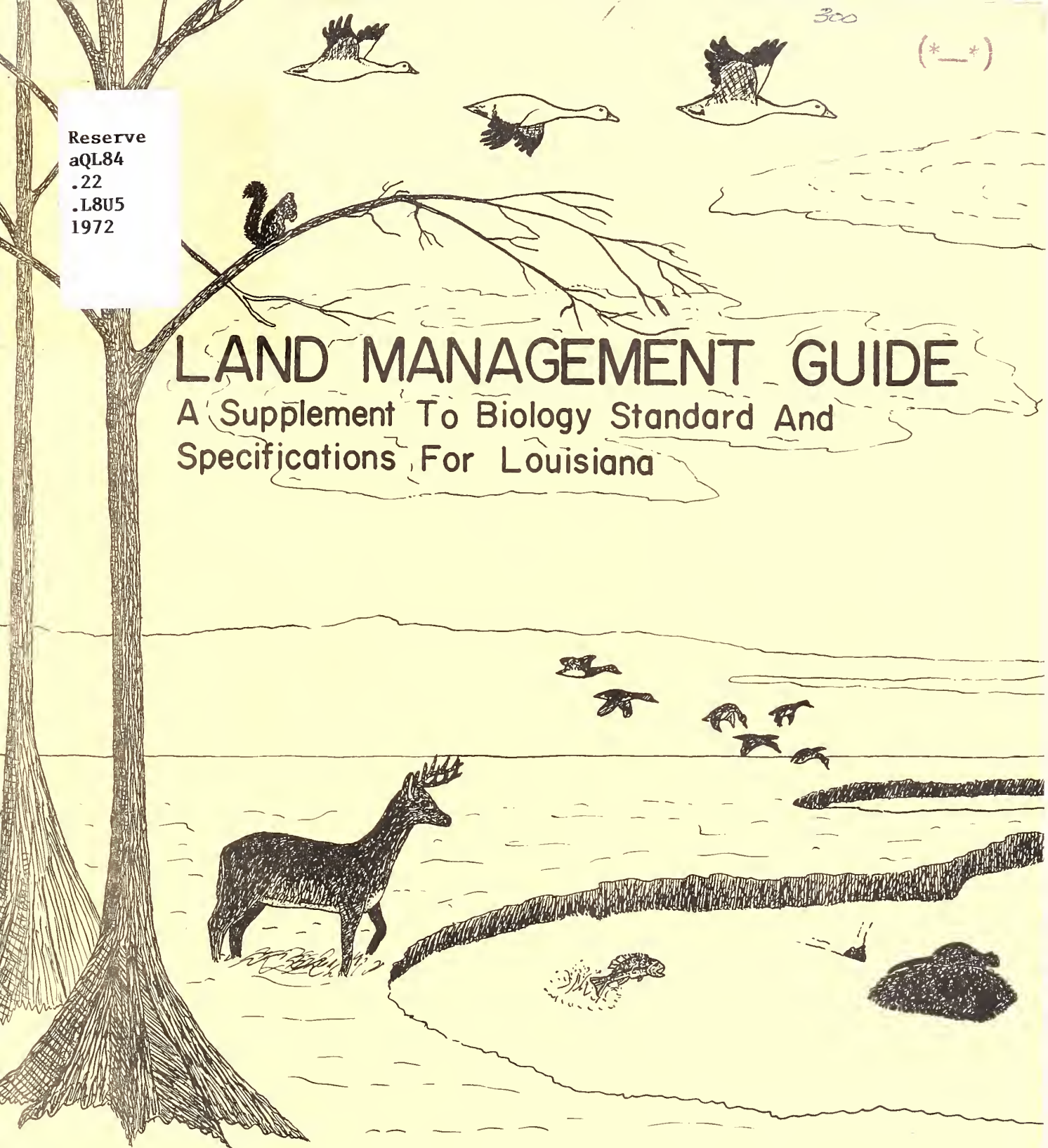

LAND MANAGEMENT GUIDE

A Supplement To Biology Standard And Specifications For Louisiana

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SOIL CONSERVATION SERVICE
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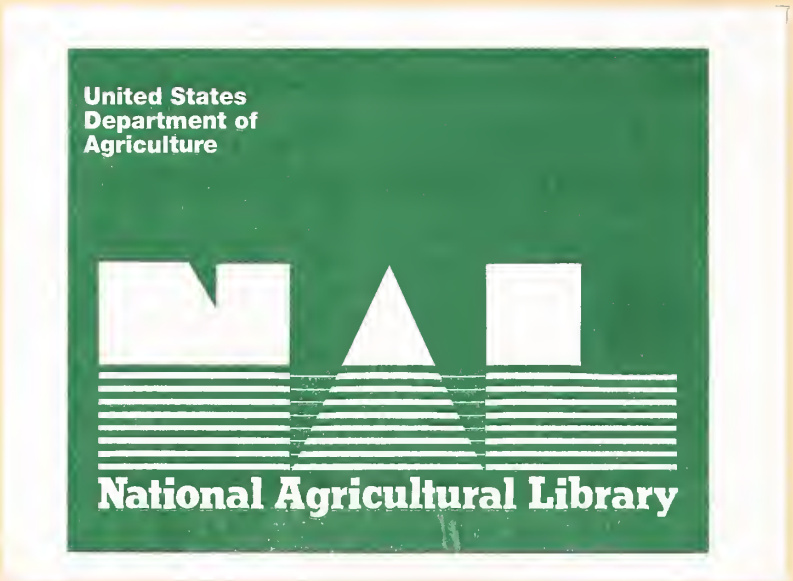
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THE OVERALL CONSIDERATION OF LAND MANAGEMENT FOR WILDLIFE

Since the Soil Conservation Service considers all natural resources in land management, wildlife should be considered when planning for the best utilization of land. When alternate land uses are discussed with the landowner, wildlife should be mentioned. If the landowner wants to plan for wildlife it can be included in the plan, if not, it can be omitted, but it should be considered.

Farmland - Farm lands can be planned in varying degrees of intensity depending on the landowner's wishes. If he wishes to use the area for a shooting preserve, the entire area can be planned for this purpose. A moderate interest can be satisfied by placing food and cover plantings wherever they do not interfere with the major agricultural enterprise. In such a situation the following practices would be beneficial to wildlife listed:

Practice:	Animals and birds benefited by the practice:						
	Quail	Dove	Rabbit	Duck	Geese	Turkey	Deer
Brush Control	x	x				x	x
Conservation Cropping System	x		x		x	x	x
Contour Farming	x		x				
Critical Area Planting	x		x				x
Crop Residue Use	x	x		x	x		
Dam, Multiple-Purpose	x	x	x	x	x	x	x
Deferred Grazing	x		x			x	x
Field Border	x		x				x
Field Windbreak	x	x	x				
Grassed Waterway or Outlet	x		x				
Hedgerow Planting	x		x				
Pasture and Hayland Management			x		x	x	x
Pasture and Hayland Planting			x		x	x	x
Pond	x	x	x	x	x	x	x
Streambank Protection	x		x				
Stripcropping	x		x				
Tree Planting	x	x	x			x	x
Wildlife Upland Habitat Management	x	x	x	x	x	x	x

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Practice: (Continued)	Animals and birds benefited by the practice: Quail	Dove	Rabbit	Duck	Geese	Turkey	Deer
Wildlife Wetland Habitat Management			x				
Woodland Improvement	x		x	x		x	x

Woodland - Woodlands can be managed for all of our game and nongame species of birds and animals. The degree of utilization of these woodlands for forest products will determine the use of these areas for wildlife. Most woodland practices can be beneficial to wildlife if they are used with good judgment. For instance, TSI, if carried out to its fullest, can remove all squirrels and most of the deer and turkey from an area. However, if the owner will leave 5 to 10 square feet of basal area of mast-producing trees per acre he can retain a modest population of these animals and benefit any turkeys in the area as well. Timber harvesting, if done as clear cutting in small blocks 20 to 80 acres in size, is very beneficial to deer, turkey, rabbits, and quail. Cuttings larger than this will remain useful to rabbits and quail, but will deminish in value to deer or turkey. Long, narrow cuttings are better for wildlife than large, square or rectangular ones.

Removal of mature trees over the area is also a highly beneficial harvest method to wildlife. These mini-openings will produce many grasses, forbs, vines and stump sprouts which prove attractive to deer, turkey, and rabbits.

Bottomland hardwoods are some of the most valuable woodland habitat there is. They should be retained and remain in hardwood permanently if the owner is willing. Deer, turkey, squirrel, raccoon, and swamp rabbits can thrive in this habitat if properly managed. In any hardwood area, grazing and fire should be excluded, particularly in the bottomlands.

Most trees, shrubs, and vines have some value to wildlife, either by producing food or furnishing den sites. Below is a list of these plants and the animals they benefit:

Plants	Animals and birds using these plants: Deer	Duck	Squirrel	Turkey	Quail
Trees and Shrubs					
Ash		x	x	x	x
Cypress			x		
Beautyberry	x		x		x
Beech	x	x	x	x	x
Blackberry	x		x	x	x
Blackcherry			x	x	x
Blueberry	x		x	x	x
Chinkapin	x		x	x	
Cottonwood			x		
Dogwood	x		x	x	x
Elm	x		x	x	
Hackberry			x	x	
Hazelnut			x	x	

Plants (Continued)	Animals and birds using these plants: Deer	Duck	Squirrel	Turkey	Quail
Trees and Shrubs (Continued)					
Hickory			x	x	
Hollies	x			x	
Hornbeams	x	x	x		
Honeylocust			x		
Locust - Black	x				x
Magnolias			x	x	
Maples	x		x	x	
Mulberries	x		x	x	x
Oaks	x	x	x	x	x
Osage orange			x		
Pecan	x	x	x	x	
Persimmon	x		x	x	
Pines			x	x	x
Redbay	x			x	x
Sassafras	x		x		x
Sumac	x			x	
Sweetleaf	x				
Sweetgum		x		x	x
Sycamore	x				
Tupelo (Black, swamp, and water	x		x	x	
Walnut			x		
Yellow poplar	x		x		
Willow	x				
Viburnums	x			x	x
Waxmyrtle					x
Vines					
Greenbriers	x			x	
Wild grapes	x		x	x	
Jessamine	x				
Honeysuckle	x				x
Rattan	x				
Trumpetcreeper	x				
Leguminous vines	x			x	x
Poison ivy	x			x	x

The upland pine areas can be useful to wildlife if a few clumps of hardwood are retained. Five to ten square feet of basal area per acre is all that is needed. These trees left will be of more value if they are left in groups instead of isolated trees scattered over the area.

In pure pine stands, controlled burning is a highly beneficial practice for forestry and wildlife as well. It causes many of our more desirable annual grasses and forbs to germinate and small brush and hardwoods to sprout. It also allows better circulation of air through the woodlands, making it more comfortable for wildlife during the summer heat. Burning also eliminates many of the pests such as ticks, redbugs, botfys, etc. that harass wildlife.

Openings in pure pine stands are valuable to deer, turkey, quail, and rabbit.

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These openings can be planted to a choice food for a target species (see individual Land Management sheets for details) or let natural succession take place. One method employed by the Louisiana Wild Life and Fisheries Commission is to bulldoze clearings and stack down timber in the center of the openings. Honeysuckle is planted in the brush pile to protect it from deer while it is becoming established.

Another practice in pure pine stands that can be very valuable to turkey, quail and to a limited extent deer, is plowing or disking strips through the woods. These strips, 10 to 20 feet wide, can also be fertilized to give the grasses and forbs coming in on these disturbed areas better growth and seed production.

In any woodland area available water should be present all year around. To furnish such water when it is absent, small water holes can be bulldozed, springs developed, and small creeks or streams dammed with low weirs to retain ponds of water during drought periods.

Marshland - See the Louisiana Gulf Coast Marsh Handbook.

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This panfish is one of the most popular for stocking in combination with bass, in warm water ponds. It provides excellent sport and the flesh is well flavored.

The color of the bluegill shades from a dark olive green on the black to a greenish white below. Along the side are a series of dark marks that disappear when the fish is out of water. The males tend to have deep orange to reddish breasts, while the females are more inclined to be light orange to yellow. The "gill tab" is typically blue-black and the lower jaw and cheek are bluish. This bluish coloration of the cheeks give the fish its common name.

Bluegills are quite prolific and spawn three or four times a year, if food supplies are adequate. Spawning occurs when the water temperature reaches 80° Fahrenheit and is accomplished by fish one or more years old, weighing at least one-half ounce. The males fan out a nest on the bottom of the pond, preferably in shallow water and on a gravelly or sandy area, in which the female deposits up to 10,000 eggs.

Frequently between 10 and 30 percent of the bream that are furnished by Federal hatcheries to be stocked with the bluegills are shellcrackers or red-eared sunfish. These fish are a desirable addition to the pond for the following reasons: (1) they grow faster and larger than the bluegill, (2) they bite more readily, start feeding earlier in the year and take bait more than the bluegill does, and (3) shellcrackers do not breed as prolifically as the bluegill. (They spawn twice a year when the water temperature reaches 75°F). Their lower reproductive capacity means that they will gradually dwindle in number and play a subordinate role in the pond's population. The shellcracker (it gets its name from the habit of eating snails) can be distinguished from the bluegill by duller coloration, a longer pectorial (breast) fin and "gill tab" having a posterior border of pink or buff. These fish will frequently hybridize with bluegill, and the appearance of the hybrid is somewhere between the two species.

Place in Conservation Planning

Bluegills will grow in any type of warm water pond that is free of excessive pollution and has a normal temperature regime. However, they do need a predator to reduce their numbers or a stunted, unfed population will result.

Food

Bluegills respond quickly when the fertility level of the water is raised. Microscopic plants and animals will be increased, which will provide more food for the young and adult aquatic insects. These aquatic insects, in turn, are the chief food of the bluegill. They will also eat tadpoles, crustaceans, mollusks, and some small fish.

Habitat

Bluegills are fresh water fish, but will live in a brackish water area. Their

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tolerance to salinities are the same as bass and can only tolerate salinities up to 8000 parts per million. They do not breed in salinities beyond 2500 ppm. Bluegills need a minimum of 2 to 3 ppm of oxygen, and the optimum pH is between 7 and 8.

Reference in Work Unit Files:

"Warm Water Ponds for Fishing", USDA Farmers' Bulletin No. 2250.

LAND MANAGEMENT FOR BOBWHITE QUAIL

The Bobwhite quail is one of our smaller game birds (5 to 6 oz.), yet one of the most important. They will live in a wide range of habitat from open pine woods to lands of intense agricultural development. However, the era of clean farming has removed much of the food and cover necessary for good quail habitat on farm land. Dairy and beef cattle operations frequently are bare of the necessary cover for quail, unless good grazing management is practiced. To restore high populations one must supply a year-round food supply and the essential cover.

Life History

Pairing off usually occurs in April. Pairs remain mated throughout nesting season. Nesting season is May through August, with a rare nest as late as October. Peak of nesting is usually May and early June. Pairs bring off only one brood each year. If the first nest is unsuccessful (no chicks hatched), pairs attempt a second, a third, or perhaps even a fourth nest. Average number of eggs per clutch is about 14. Incubation period is 23 days. The hen usually incubates the eggs; but incubation may be performed by the cock. Chicks are capable of short flights at 2 weeks of age (about size of tailless house sparrow). Quail reach mature size at 14 to 16 weeks of age. The young may remain in the same covey with their parents, or they may join with quail from other hatchings to form coveys. Coveys break up in April when the members pair off for breeding.

Potential life span is about 8 to 10 years, but few reach that age. Average life expectancy is less than one year. About 70 to 80 percent of the fall population are young that were hatched during the same calendar year.

Place In Conservation Planning

The Bobwhite quail can be grown anywhere in the state if suitable habitat is present and flooding isn't a problem. The habitat can be planted, preserved when land is being cleared, or just let the land revert to the native vegetation, then hold it in the proper ecological condition.

Food

The quail's food consists of 15 percent animal matter and 85 percent vegetable matter. The animal food is chiefly insects, in which beetles, bugs, caterpillars, crickets, and grasshoppers predominate. The vegetable matter is composed mainly of seeds and fruits, although some greens are taken. The commonly taken native wild seeds are: acorns, beggarweeds, blackberries, dogwood fruits, goatweed, honeysuckle, milkpea, partridge peas, panicum and paspalum grasses, pine mast, signalgrass, ragweed, and vetch. Many agricultural crops are taken and the favorite of these are: Browntop and other millet, corn, cowpeas, grain sorghum, lespedeza (Kobe, Korean and shrub), peanuts, soybeans, and wheat. If cattle are using the area where improvements are planned, plantings must be fenced.

One planting of one-fourth to one-half acre of food per 20 to 25 acres is usually adequate for one covey of Bobwhite quail if other cover requirements

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are met. When planning a farm, remember food plots should be placed away from dense cover to insure an adequate harvest. Rather than placing them on the edge of the woods, put them out in the field or at least 20 yards from woodland and connect the woodland to the food patch with an unmowed strip of brush or grass. When the birds are flushed, the hunters have a better chance of an open shot. Plant next to the woodland only as a last resort and then use low forms of preferred vegetation.

Cover

Nesting is generally undertaken on the ground in grassy or herbaceous cover, next to bare soil. Last year's grasses with bare ground close to the nest site are preferred. Escape cover is found in the form of thickets or brush, young pine plantations, honeysuckle patches, blackberry or brier tangles, or blocks of thick woodland. Roosting is done in open fields, in low, open cover (6 to 18 inches high) where flight is not restricted in any direction. Quail roost in a circle, heads out and tails towards the center. Cover from inclement weather is found in young pine plantations, honeysuckle patches, sericea lespedeza plantings, or any other dense type of plant cover. On farms barren of cover, planting of sericea lespedeza, hedgerows of native vegetation or multiflora rose, or ditchbanks, spoils, and berms left in weeds will alleviate the cover shortage.

Hedgerows of multiflora rose or native plants are very useful to quail and will provide cover in many fields which would not normally be used. These hedgerows are at their best if they connect with a larger body of vegetation, such as a woodland, brushy area or abandoned fields.

Water

While generally not absolutely necessary, available surface water is a desirable adjunct to the habitat.

Range

The annual range of a covey rarely exceeds a square mile and the daily range is generally less than one-fourth of a square mile. The closer together the necessary types of cover and food are, the smaller the annual range will be.

Nesting

Quail suffer a high annual mortality whether they are hunted or not. A 70 to 80 percent population turnover annually, (from September to June) is not unusual. Food shortage, cold and/or wet winter weather, predation, disease and old age cause this high death rate. Even with this great loss in numbers, the surviving birds can repopulate their home range if successful with their nesting.

After the covey breaks up in March or April, depending on the weather, the quail pair off and build a nest in dead grasses, herbs, or other low, dense cover. Last year's grasses seem to be preferred over other vegetation. Patches of grass such as lovegrass, fescue, orchard, or others can be planted

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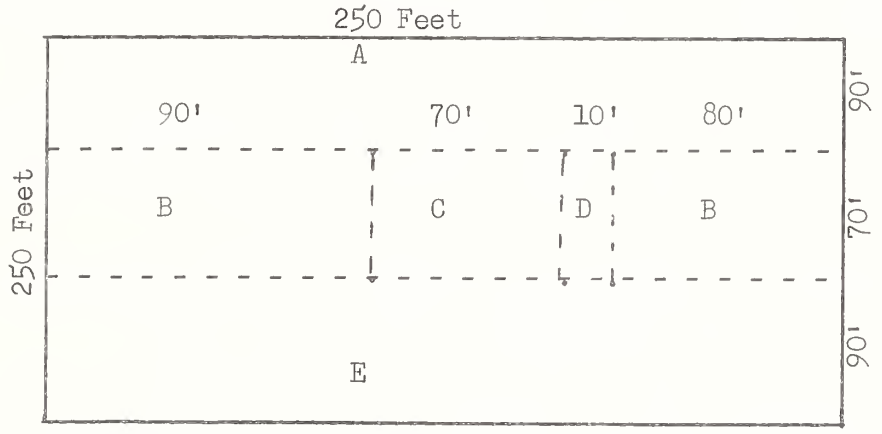
specifically for nesting. If, for any reason, the nest is destroyed, attempts to renest will continue into September. Only one brood is raised a year. Both the cock and hen are very devoted parents and if a hen is killed the cock will take over the incubation and rearing duties. In fact, unmated cocks will frequesntly try to lure the young away from a mated pair to raise them himself.

Management

The management of the Bobwhite is based on an adequate annual food supply and a good dispersion of cover. Maintaining brushy cover, honeysuckle patches, brier and blackberry thickets, patches of sericea lespedeza, and unmowed patches of grasses and annual weeds, and hedgerows scattered over the farm will fill the cover requirements of quail. Plantings of Browntop millet, common, Kobe, Korean and Bicolor lespedeza, cowpeas, soybeans, and other crops mentioned under "Food" will supply adequate food. The Bicolor lespedeza plantings are very desirable and are "insurance" against crop failure of annual plantings. However, Bicolor lespedeza is limited in this state by free ranging cattle, gophers, leaf cutting ants and wet soils. Common, Kobe, or Korean lespedeza can be substituted for bicolor in most of the upland soil. The annual plantings are supplementary and increase the attractiveness of the area for quail. Browntop millet is an especially choice food and can be planted early in the spring as a midsummer food.

A unique management technique has been developed in Georgia that has merit for land that is to be devoted exclusively for quail. It consists of a square 250 feet on the side, which contains all the elements necessary for food and cover. Establish one per 20 to 25 acres. See diagram below with footnotes.



Select seed or plants from each group to meet local soil conditions.

Plant one kind of seed or plant from each group: A, B, C, D and E.

A. Browntopmillet, Dove proso, or Chiwapa japanesemillet (10 lbs. seed).

B. Hairy vetch, yellow vetch or gradiflora vetch, 3 lbs. each planting, (6 pounds).

C. Shrub lespedeza - bicolor, japonica or thunbergii, (700 to 800 plants).

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D. Pfitzer juniper, pyracantha, autumn olive or Yaupon (4 or 5 plants).

E. Annual lespedeza (Kobe, Korean or Common), (8 pounds).
or
Corn and Florida beggarweed (Corn, 6 pounds
Florida beggarweed, 2½ lbs. scarified seed)
or
Cowpeas and soybeans (cowpeas, 1/4 bu. of Tory, Iron, Clay, Covington
or Thronsby cream
(soybeans, 1/4 bu., Gatan or Laredo).

One side of planting should be adjacent to woods or wildlife cover (hedge row, field border, etc.).

Rotate A and E every other year. Plant on contour or sloping land.

Woodland Management

The production of quail in the pine stands of the south is traditional. To maintain the highest quail populations on a wooded area, three things can be done (1) control burn every three years, sparing some dense cover by fire lanes, (2) disk and fertilize strips through the woods, and (3) make plantings wherever openings are available.

Controlled burning does several things that benefit quail; it removes ticks, redbugs, snakes, and other vermin that annoy them; encourages the growth of annual grasses and weeds (the seeds of which are choice quail foods); removes the undergrowth to a point where air circulates more freely, creating more tolerable summer conditions; and releases nutrients which cause the annuals produced to grow better.

Disking strips through the woods produces annual forbs (beggar-tick, wild lespedezas, wooly croton, partridgepea, etc.) and grasses (panicum and paspalum grasses mainly). Fertilization causes these to grow more vigorously and produce more seed.

Plantings of bicolor or low lespedezas, browntop millet, cowpeas, and other acceptable quail food crops furnish more food for the birds present and allows these birds to expand their population.

The harvest of timber is also beneficial to quail because it stimulates the growth of more desirable plants. This is caused by allowing more sunlight to reach the forest floor; soil disturbance by logging (exposing buried seed); and any burning of slash. A well managed forest usually will maintain a few covies, about 11 birds per 100 acres. Controlled burning annually, and planting (10 acres/100 of woodland) of foods produced 50 birds/100 acres.

Retaining oaks, sweetgum, dogwood, wild cherry, and mulberry will provide additional food for Bobwhites.

Harvest

You can't grow large crops of quail and expect them to live over the winter.

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Natural mortality will reduce the numbers by an average of 70 to 80 percent whether they are hunted or not. However, when hunting, don't reduce a covey below 20 to 25 percent of its fall population level.

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The channel catfish is a native of Louisiana's streams and rivers. It is valued as a sport fish and a food fish. It can be grown in ponds, and heavy yields can be obtained by proper supplementary feeding. Its body is without scales, slender, light blue to gray with dark spots, and has a forked tail. The channel catfish may reach a size of 20 to 25 pounds, but the more common size is 1/2 to 5 pounds. It feeds on almost anything organic, dead or alive. More common foods are small fish, crawfish, snails, frogs, and various insects. Spawning usually occurs during May or June. About 4,000 eggs are laid per pound of body weight. The male drives the female from the nest soon after she spawns. He fertilizes the eggs and takes over the hatching duties until the young hatch.

Place in Conservation Planning

Catfish can be grown in any kind of a pond that is suitable for bass and bluegills. For commercial production the pond must be drainable. A dependable source of clean water, free of wild fish, is also necessary for commercial production.

Management for Sports Fishery

Stocking

There are three ways in which catfish can be stocked; alone for sports fishing on an unfed basis; with a bass-fathead-minnow combination with feeding; and with a bass, bluegill combination.

For sports fishing alone, one can obtain from the Department of Interior up to 100 catfish fingerlings per acre on an unfertilized basis. Ponds down to one-fourth acre in size can be stocked with this fish. With feeding, 2,000 pounds per acre can be produced, but these fingerlings must be bought by the landowner since the U. S. Fish and Wildlife Service will not furnish fish for a commercial use.

In combinations, channel catfish can be stocked with bass and fatheads. Three thousand channel catfish, one thousand fathead minnows, and fifty largemouth bass are stocked per acre. The bass are included to control any undesirable fish that might enter the pond. The fathead minnows are produced to feed the bass and to a lesser extent feed the catfish when they become larger. Stock the catfish during the winter months, feed at the same rates used for commercial production 1/ and start fishing in the spring. This combination will furnish fishing about two or three years, then it is best to drain the pond and restock.

A combination of bass, bluegill and channel catfish will work well as long as catfish are stocked before, or along with the bluegills, at the rate of 100 per acre. After all or most of the catfish have been caught they may be restocked, provided the fingerlings are large enough (6 to 8 inches) to escape

1/ Do not exceed 30 pounds of feed per acre per day.

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bass predation. The addition of catfish to a bass, bluegill combination will reduce the bluegill growth by approximately 50 percent.

Reproduction can be obtained from channel catfish if suitable spawning containers are present and if bass or other predators are absent. This is successful and can be done in the ponds stocked with channel catfish alone.

Feeding

The feeding of catfish is undertaken on a body weight per acre basis. Some people feed 4 to 6 percent of body weight per acre during the first 3 to 6 weeks, then reduce this to 3 percent of body weight. For a more detailed discussion of feeding see section on commercial catfish farming.

Commercial Catfish Farming

I. Water

A clean, abundant supply of water is essential to the success of fish farming. The water should be free of pollution, and any kind of fish. The supply should be adequate to change the volume of the pond within 48 hours.

The best source of water is a well. An 8-inch well capable of producing 1,000 gallons per minute is ideal, as this water will be free of fish or their eggs. However, when it is pumped into a pond, it should fall at least 2 feet or more to help aeration. If the incoming water could hit and splash on some object, such as a wooden platform, it would pick up more oxygen than if it just fell 2 feet. Most well water is low in oxygen (O_2) and high in nitrogen (N_2) and carbon dioxide (CO_2).

If water is pumped from a stream, bayou, lake, canal, or any other body of water (which of course is free of harmful pollutants), it should be filtered to prevent the introduction of other fish or their eggs. An excellent way to do this is to use a saran filter.[2/] These filters, made in the form of a sock, will keep out "wild" fish and their eggs, and still pass 800 gallons per minute. These filters can be made from 3 ft. x 12 ft. rectangles of saran. These rectangles should be sown into a tube, closed at one end and with a drawstring at the other. The drawstring should be tied over the inlet pipe and the filter supported over its entire length. If volumes over 800 gallons per minute are to be used, it should be filtered through a box filter. A box filter is a box of approximately 5 ft. x 5 ft. x 5 ft. dimensions, supported 18 inches or more above the water by pilings. The boards of the box are spaced several inches apart and the filter material nailed to the inside of the container. The well flow is directed into the box and should hit several boards placed at an upright angle, which breaks the initial force of the water.

Sand and gravel filters have been used, but have not always been successful.

A strong spring may also be used but it would still be a good practice to filter water from such a source.

2/ Saran screen filter, style MS907, National Filter Media Corp., Western Div. P. O. Box 156, Salt Lake City, Utah.

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II. Ponds

Ponds can be the impounded or leveed type. If the leveed type is used and built with a dragline, it is best to have the borrow ditch on the outside. This will provide a level bottom with the correct slope for complete drainage and room for a properly constructed harvest pit. Inside borrow ditches can be used if they are properly sloped and graded. These are best used in the larger ponds to provide adequate and quicker drainages. These ditches should have gently sloping sides and should have the proper fall to drain water to the harvest pit. This type of pond can best be constructed by a bulldozer and the borrow ditch shaped by the dozer or a motor grader.

Bulldozing in any size pond is generally the cheapest method of construction.

The beginner should start with small ponds and as he gains experience he can expand and build larger ponds. However, larger ponds, 20 acres and up, will produce tremendous poundages 3/ of fish to handle at harvest time.

Levees to be constructed should follow SCS engineering specifications. They should have tops wide enough to carry vehicular traffic, which will facilitate levee repairs, feeding and harvesting operations.

Depth of the pond can range from 2.5 feet to 6 feet. With these depths, aquatic weeds can be controlled easily.

The water control structure should be capable of draining the pond completely and within a 48-hour period. This is to prevent fish from dying from an oxygen depletion caused by crowding when water becomes low. Ponds also should be screened to prevent fish from escaping.

If ponds are arranged in a series, water leaving one pond should not be permitted to enter another. This is to prevent the transmission of diseases, parasites or wild fish from one pond to another.

Each pond should slope to a harvest pit, which should be approximately 10 percent of the pond area. Circular harvest pits have proven to be the most successful, as fish are more easily seined from this type. Harvest pits should be one foot or more deeper than the rest of the pond bottom.

III. Stocking

Channel catfish are generally used for catfish farming, although blue catfish have recently shown promise in SCS field trials in Arkansas.

Cooperators should buy their fish from a reputable dealer, who will stand behind his product. Fish should be healthy and free of disease.

3/ An acre of water can produce between 1200 and 1700 lbs. of fish during a 210 to 240 day period.

Most dealers transport their fingerlings in a .001 percent solution of acriflavine. This inhibits bacterial growth during transportation. If it is possible, fingerlings should be held in a 15 parts per million formaldehyde solution for 24 hours prior to shipment. This is a therapeutic treatment for disease and parasites.

The suggested stocking rate is 2,000 fingerlings per acre, although 1,500 to 3,000 per acre have been used. The smaller number of fish stocked, the larger the size that can be produced in a given time. These fingerlings should be stocked in February or March. Fall stocking can be made, but such stocking suffers a greater mortality than one in the spring.

The cost will be between 3 to 10 cents per fingerling, depending on size and time of year ordered.

IV. Feeding

Fertilization should be limited to two applications of 40 pounds each of 20-20-5 per acre (8-8-8 may be substituted if 20-20-5 is not available). Fertilization is not economical after this because fish are not dependent on natural foods. Continued fertilization, coupled with nutrients released from unused feed and fish droppings can cause heavy algae blooms. These blooms may cause an oxygen deficiency if they die suddenly and decompose, or come to the top and form a scum, which cuts off the sunlight to the rest of the phytoplankton.

Feeding is accomplished by using a pelleted feed based on the Auburn No.2 formula. This formula should contain 28 to 45 percent protein, 4 to 8 percent crude fat and 8 to 10 percent crude fiber. Most fish feed is composed of such items as soybean meal, fish meal, poultry by-products meal, meat and bone meal, alfalfa meal, rice mill by-products, cottonseed meal and a vitamin package or the equivalent of any of these items.

The cost of such feed is approximately $110 per ton. If larger quantities are bought, the cost can be reduced. Arrangements could be made with other fish farmers and large orders placed at local mills. This could reduce feed prices overall and operation expenses.

A floating pellet is also made but it costs more than the sinking feed. Even with this increased cost, Dr. J. W. Avault at Louisiana State University believes the floating pellet is better because you get better utilization of your feed. You know if your fish are feeding (and if they aren't you can discontinue) and you get a better look at your fish and their actions. Floating feeds cost 8.5¢ versus 5.5¢ per pound for sinking feed. Feed cost runs around 6¢ to 10¢ per pound of catfish produced. The conversion rate[4/] for channel catfish is approximately 1.87 - with a range of .77 to 2.13.

Feeding should be undertaken at the rate of 3 percent of body weight per

4/ A conversion rate is the pounds of food needed to produce a pound of meat.

day, 6 or 7[5/] days a week. This body weight must be determined by seining weekly or bi-weekly for best growth rates. Assume a 90 percent survival of fish. Catfish grow rapidly during their first few months of life, so frequent seine samples are necessary.

The feed should be distributed at least along the long axis of the pond daily, preferably halfway around the pond, rather than at one location. This will give better distribution of the feed and not allow a gang of "hogs" to get all the feed.

Precautions on feeding:

1. Avoid feeding during rainy weather, especially if using sinking pellets.
2. Reduce feeding weight by one-half when the water temperature exceeds 90°F.
3. Stop feeding during overcast, hot, still weather.
4. Do not feed more than 30 lbs. per acre per day during July, August and September.
5. During the winter when water temperatures fall below 60°F, reduce feeding to every third or fourth day and feed .005 percent of body weight.

V. Spawning

Some people intending to spawn their own fingerlings start out by purchasing brood stock. Others buy fingerlings and raise them to maturity for brood stock. Either way, it will take skill, patience and effort to produce one's own fingerlings.

The economy of producing your own fingerling is evident when one considers it costs approximately 1.5¢ to produce each fingerling. This figure, compared to 3¢ to 10¢ per fingerling paid to a producer, will result in a considerable savings on the initial investment.

Ponds for spawning can be of any size, but usually the smaller sizes are preferred. This is especially so for breeders who don't use pens in their spawning operations.

Spawning is done in 10 gallon milk cans which have been covered with black asphalt to preserve and make them darker. These are placed in water two to three feet deep facing deeper water. One hundred pound grease cans also can be used.

To have direct control over spawning catfish, many operators are employing spawning pens. These are 5 feet wide by 10 feet to 12 feet long and covered with 1 to 1½ inch mesh welded wire on four sides. The depths in these pens range from 2 to 4 feet.

5/ Professor E. E. Prather reports a 12 to 15 percent increase in total pounds produced if a 7-day a week feeding is done, as opposed to a 6-day feeding schedule.

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The brood stock should be from 3 to 10 pounds in weight and in good condition. The larger and older brood fish will usually spawn earlier than smaller and young fish. Males should be larger than females, because the male forces the female into the act of spawning. The operator of any spawning operation must be able to distinguish the sexes.

These fish should be selected in the fall and kept in separate ponds. They are given a diet containing cut fish, liver or other animal flesh to prepare them for spawning. This diet should start with a little cut fish, and continued by increasing to larger amounts during winter until they are eating as much as they want.

The male and female are placed in the spawning ponds, or pens, as the case may be, sometime in late April or May. When the water temperature fluctuates between 65° and 72°F, spawning begins.

Males induce females to lay eggs. After fertilization, incubation starts. If the fish are in pens, the female may be removed at this time because she might harrass the male by trying to eat the eggs. However, this is not absolutely necessary. Between 6 and 10 days, depending on the water temperature, eggs should hatch. While incubation is in progress, loud noises, slamming of car doors, etc. should be avoided around the spawning pond, because this may excite the male, who might eat the eggs.

After the spawn has hatched, the spawning container can be taken out and the fry removed. If spawning is not undertaken in pens, empty the milk container of fry and remove it, letting the fry work their way out into the pond. If the can is returned within 24 hours, the male will fan the fry back into the container and resume caring for them. Later, the adult catfish are removed by seining with 1 to 1½ inch mesh seine which has been treated with asphalt varnish to prevent the spines from tangling into the mesh. The fry are then fed and raised in the pond.

If fry are removed from the brood pond, they should be put into a separate pond or a feeding trough. Fry should not be fed until the fourth day or until they have absorved the yolk sac. Three to five days after the yolk sac has been absorbed, feeding can be started. The food fry and fingerlings use is different from adult fish and is fed as a mash rather than pellets. Many feed companies now handle fingerling feed.

If a pond is used for fingerlings, it is best to keep it dry until fry are ready to be transferred. The pond can then be filled. This method keeps down predaceous insect populations. After the pond has been filled for a short time, water should be treated to kill any predaceous insects that have entered. These insects are air breathers and can be controlled by covering the surface with a film of oil. Mix one quart of motor oil to five gallons of kerosene and pour gently on the windward side of the pond. The wind will spread it over the pond's surface.

If spawning is conducted in pens, the male can be fed cut fish after he has raised a brood. Then he can be supplied with another female to produce additional broods. If the temperature of ponds can be maintained at the desired level, spawning can be prolonged into the early summer.

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VI. Fish Kills, Causes and Cures

Catfish die for many reasons, but the biggest killer is an oxygen (O_2) deficiency. Catfish require less oxygen than bass and bluegills, but during the production period above normal numbers are held in a pond, and consequently the demand for oxygen is much greater. When any form of organic material decomposes in a pond, such as unconsumed food, a planktonic bloom or a filamentous algae infestation, oxygen is removed from the water and the fish suffer. Oxygen shortages also occur during hot, still, cloudy weather. Hot water will physically hold less oxygen than colder water. Windless days don't afford the opportunity of wave action, which causes a mechanical mixing of air and water (air contains 21 percent of oxygen). Finally, cloudy weather reduces the food manufacturing of plankton in the pond. During the process of plant food manufacturing (photosynthesis) carbon dioxide and mineral elements are taken from the water and within the cell, using sunlight for energy, a simple sugar is produced. A by-product of this process is oxygen, which is released into the surrounding water. This oxygen is highly important to fish.

When any of the above conditions occur, a fish kill is possible. To avoid a kill, observe the rules on feeding mentioned before and always check fish early in the morning. Early in the morning, just before dawn, the oxygen is at its lowest level, and if fish are being affected, they will be coming to the surface and "nosing" the top of the water. This is called "piping", and a sign of oxygen deficiency.

When oxygen deficiency is imminent or present, start pumping water into the pond. Try to make the stream hit an object so it splatters. The more finely divided the drops of water are, the larger the water surface exposed to air and hence the more oxygen is absorbed. If water is pumped directly from the well, spattering is important, as well water contains very little oxygen. If water is circulated in the pond by pumping, keep the intake in the top foot or so. Deeper water contains even less oxygen than the surface water.

Diseases and parasites are something a fish farmer will need to recognize or at least have facilities for diagnosis nearby. In Louisiana, the Wild Life and Fisheries Commission have a diagnostic laboratory at Monroe (Post Office Box 4004, Ouachita Station, Monroe, La. 71201, Phone 325-8266) which will offer assistance when a disease or parasite infestation occurs. The Fish Farming Experiment Station at Stuttgart, Arkansas also offers this service and can be reached by phoning (501) 922-6775.

A discussion of diseases and parasites and their symptoms is far too complicated to be included here. When disease or parasites infest a fish population, the best thing to do is contact a competent fishery biologist or the diagnostic lab of the Louisiana Wild Life and Fisheries Commission and let them make the diagnosis.

Troughs or tanks are good places to treat fish to cure diseases or parasites. Treatment also can be done in the pond. The former is most desirable, because more accurate measurements can be made, and they are much cheaper than pond treatments. Tanks can be constructed of exterior

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plywood, using glue and bolts, or of concrete. Concrete, being rough, and capable of scraping catfish (which bruise easily) can be lined with polyethylene to prevent injury. The plywood, if painted, should be painted with lead-free paints. These tanks can be built to dimensions that will hold a definite number of gallons, which will greatly facilitate getting the correct ppm solution. For example, a tank one foot deep, two feet wide and eight feet long holds 100 gallons.

Tanks should have a drain at one end and an inlet for water at the other, so that the water can be changed rapidly.

If the pond is treated, as accurately as possible, obtain the volume of the pond in cubic or acre feet of water. This is absolutely necessary for accurate preparation of the correct parts per million (ppm) of the therapeutic solution.

At this time, the only therapeutic chemicals cleared by the F.D.A. for use in catfish production are copper sulfate, salt, sulfamerazine and terramycin.

VII. Harvesting

Harvesting is accomplished by drawing the water off and concentrating fish in the harvest pit. Then the harvest pit is seined and fish removed. Some fish farmers will sort out smaller fish and put them into a holding pond to feed for a larger size.

The production cycle of February-March to October-November should yield fish around 1 to 1 1/4 lbs. at the 2000 fish per acre stocking rate. Three thousand fish per acre will yield a fish about .7 lbs. during a production cycle, while 1500 will yield an average fish of 1½ lbs. From 1200 to 1700 pounds per acre are produced, with an average of 1500 lbs. per acre. With such poundages it is evident that an operator will need to have a ready market, or facilities for handling and holding large poundages of fish.

If a smaller quantity of fish is desired, partial harvesting can be used. This can be done by feeding, then using a seine to surround the fish.

Some operators are continuously removing fish by traps or trot lines and selling them locally. Now that the 14-inch limitation on pond reared catfish has been removed, continuous harvesting can take place. Some landowners are building processing rooms to handle fish for local sales.

Harvesting by the Fishout Pond System offers promise for those farmers who like to have people around. A fishout operation calls for the producer to let the public come in and catch the fish right from the pond. Usually a $1 fee is charged for fishing and $.50/lb. for fish caught. The producer may also have a small concession stand at the pond to sell bait, cold drinks, etc. This will be an additional income source. Usually the producer has one or two ponds devoted to fishout and confines the public to these. His other ponds produce the fish to be seined out and placed in the fishout pond.

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The price per pound for catfish ranges from $.40 to .70 live weight and $.85 to 1.15 dressed. The price will depend on the market and time of year. The prospective operator should carefully investigate the market potentials before deciding whether he should get into the business, and what phase of the business he should enter.

If fish are to be trucked live, they should be held in tanks or troughs for 24 hours to empty the gut. This helps prevent ammonia buildup from fecal materials during transportation. Aeration units must be available on trucks when fish are transported.

Three other points must be observed when entering this business. (1) The Louisiana law requires a $10 fish farming permit which is purchased annually. (2) If fish are to be hauled out-of-state, a $50 wholesale fish dealer's license is required. (3) The Louisiana law requires notification of the Louisiana Wild Life and Fisheries Commission 48 hours in advance of transportation over Louisiana highways for any fish under 13 inches.

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Two species of crawfish are commercially produced in Louisiana; the red swamp and the white river. Generally, there are more of the red swamp variety grown than the white river.

The peak of the breeding is believed to occur in May and June. It is during this time that the male deposits his sperm into an external receptacle of the female. These sperm remain viable and held by the female until the eggs are laid in September or early October.

When natural bodies of water dry up in the summer months the crawfish burrow in the ground and remain there during most of this dry period.

As the eggs are laid during the early fall, they are fertilized by the male's sperm contained in the external receptacle. The eggs are attached to the underside of the female's tail by a sticky substance called glair, and remain there until they hatch. The young hatch while the female is in the burrow, usually in October, and stay with her until she leaves the burrow. As soon as flooding occurs, the female releases the young and they become free swimmers. After leaving mother, the young ones will spread out and feed in shallow water. While crawfish will eat both animal and plant matter, their main food is tender vegetation. Their growth is very rapid and in 5 to 8 months they are the size of their parents. The best temperature range for growth is 70° to 85°F.

Harvest generally begins in February, but if prices are high and the young have grown well, the harvest may start in December.

Place In Conservation Planning

Crawfish can be grown in swamps, marshes, rice fields, or any area having a watertight clay or silt soil. The area needs to be relatively flat, must have a nearby water source (surface or ground), and free of deep flooding.

Habitat Requirements

Water Quality and Quantity

Water for crawfish production should be free of pollution (industrial and pesticides) and wild fish. Well water is preferred, but surface water can be used. Highly acid or alkaline water should be avoided. A high iron content can be removed by letting the water set several days in a pond or running it down a ditch for 200 feet or so. Strongly saline water should also be avoided but a little salt is thought to be beneficial. Crawfish can be grown in coastal marshes where the salinity does not exceed 800 parts per million. The water, when entering a pond, should be allowed to fall and splash as much as possible to build up the oxygen level. The oxygen level should be 2 ppm or greater, because lower concentrations inhibit growth and feeding. At 1.5 ppm, crawfish will die in traps if left overnight.

The water source of a crawfish pond should be adequate to fill it within one or two weeks, or less.

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An average of 18 to 20 inches of water is ideal, but water depths can range from 0 to 48 inches. No more than 25 percent of the pond's area should be in water 3 feet or greater.

Food and Cover

These two items are usually the same. Crawfish will feed on both animal and plant matter, but in a crawfish field the latter supplies most of the food. Tender plants are a preferred food and Browntop and Japanese millets, clovers, sorghums, and various plants are the best to plant. Smartweed, alligatorweed, duck weed, and water primrose are the best native plants to establish and encourage. Alligatorweed does have the disadvantage of becoming too dense at times and inhibits harvesting of the crawfish. Cattails, rushes, water hyacinth and other tough plants are not used and also hinder the harvest of the crawfish. Cover is essential to protect the crawfish from their many enemies. Fish, wading birds, mink, otter, bullfrogs, snakes, raccoons, turtles, and other animals prey on these crustaceans.

Site Location and Construction

Site Location

A relatively flat site with watertight soils is needed for crawfish ponds. Some of the best soils for these ponds are Baldwin, Crowley, Harris, Iberia, Portland, Sharkey, Moreland, Norwood, Yahola, and Alligator. An adequate water supply should be nearby.

Construction

Levees should be constructed to the engineering standards and specifications and they should be wide enough to carry vehicular traffic to facilitate harvest and levee repairs. They should also be high enough to keep out flooding during periods of high water outside the pond area.

Ponds should be limited to 300 acres or less. Ponds larger than this are difficult to manage, especially if an oxygen deficiency occurs. Wooded ponds have proven undesirable compared to cleared areas. The reason for their undesirability are:

1. More difficult to harvest because of trees and brush.

2. Harbors more predators, snakes, raccoons, wading birds, etc.

3. The water temperature is lower during the winter months because of shading. This retards crawfish growth.

4. They have more decaying organic materials and have lower oxygen levels as a consequence. "Blackwater" conditions are more common in wooded than open ponds.

5. The trees block the wind and wave action is reduced; this in turn reduces the mixing of air and water and hence less oxygen is produced.

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If at all possible, it would be desirable to clear the area of standing and fallen timber. This debris should be stacked and burned.

The end of pipe bringing water into the pond can be altered so that it will cause the water to make a coarse spray. If this isn't done, the water can be made to fall on a platform and splatter. Either of these two methods help build up the oxygen level.

A water control structure is necessary to maintain the level of the pond and carry off surplus water from heavy rains.

A dependable all-weather road to the pond is desirable to facilitate repairs, harvest and management.

Management

The production cycle of a crawfish pond calls for the water to be lower in late May or June. The exact time will be determined by the demand and market prices. The water level should be lowered gradually, over a two to four week period, so as to give the crawfish time to burrow in and prepare for the summer dry period. Rapid water removal will expose the crawfish to predators.

If the area that is being planned as a crawfish field does not show any sign of crawfish (burrows, etc.) it would be wise to stock it. Stocking will depend upon the cover conditions existing at that time. See below:

Dense vegetation and crawfish naturally present - 10-15 lbs. per acre.
Dense vegetation and crawfish absent - 20-25 lbs. per acre.
Densely wooded pond or open pond with thin cover - 40-60 lbs. per acre.

Stocking is best done during May or June since at that time the price of crawfish is lowest. The pond should be flooded two weeks before the stocking takes place. Try to get large crawfish, 12 to 18 to the pound, and they should be fresh. Do not buy crawfish that have been held in cold storage overnight.

During the months of June, July, and August, vegetation, native or planted, can be grown. Browntop or Japanese millet, clovers, ryegrass or any other tender grasses can be planted, or smartweed, water primrose or alligatorweed established. If a dry summer occurs, temporary flooding may be necessary to irrigate this "crop" of vegetation. Fertilization of this "crop" will assure better growth, which will insure more cover and food, and therefore better crops of crawfish. Fertilization of the water, such as one would do in a farm pond, does not materially benefit crawfish. Excess fertility should be avoided.

If native vegetation is grown, it should be plowed or disked every second year to prevent tough, undesirable vegetation from taking over.

In September, the water should be added. This can be done rapidly or slowly. It makes little difference which way it is done, as long as it is started in September. An early flooding during this month allows the newly hatched crawfish a chance to leave the burrow of the female and start feeding. This

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will give them more time to grow and become large enough for harvest earlier. This will put them ahead of the "wild" crop. However, if surface water is added, check the temperature. If it is above 90° Fahrenheit, do not flood until it cools below this temperature. Water at 90° or above can kill the crawfish in their burrows.

Around December the size of the young can be checked to see when harvest can start. Some people start the harvest in December if the crawfish are large enough, and if the market price is high enough. Generally, the harvest starts in January or February and continues through May. The length of the harvest period is dependent on market prices and the number of crawfish caught.

The level of oxygen in a crawfish pond is not as critical as that in a catfish pond, but it still is necessary to keep it at a desirable level. There are two important reasons for this, (1) crawfish feed better and grow larger in higher oxygen levels, and (2) they will live better in the traps if an adequate oxygen level is maintained.

Two indicators to check for oxygen level are; water color and crawfish seen clinging to vegetation out of the water. If the water is dark, "blackwater condition", the chance of an oxygen deficiency is great and the pond should be flushed out with fresh water. This same action should be taken if a number of crawfish are seen out of the water clinging to vegetation. Low oxygen levels are most prevalent when the wind is calm and the sky is overcast.

Fish should be excluded from a crawfish pond by all means. This can be done by filtering through a fine wire screen box, at the intake of the pump, or using a saran filter at the outlet. "Fish-free" water is one of the best reasons for using well water. Any deep, natural holes or borrow pits that retain water when the field is drained should be rotenoned before the pond is refilled. If fish have somehow entered the field they can be removed by applying rotenone at the rate of 2-3 ppm. Do not exceed 5 ppm as that concentration will kill small crawfish.

Rice fields are frequently used to produce a second crop of crawfish. The management of these fields are essentially the same as the management previously discussed, with the following exceptions:

1. Check and see if the field has had a long history of insecticide use. If it has, chances are that crawfish are absent and will not successfully grow in such a field. Aldrin treated seed should also be avoided if crawfish are to be grown.

2. The levees on a rice field may not be high enough to hold the amount of water necessary for crawfish production (12 to 30 inches). Additional height may have to be added to compensate for this deeper water.

3. Because of the time when rice is to be planted (April) the field may have to be drained earlier (if the seed is not water planted) so allowances in harvest must be made for this earlier drainage.

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4. After harvest, allow the stubble a chance to sprout and then add the water. If the water level is kept low, 6 to 8 inches, for several weeks, greater growth of the stubble can be made.

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LAND MANAGEMENT FOR DUCKS

Ducks are usually divided into two groups: the surface feeders or puddle ducks, and the divers. These can be separated by their mode of feeding, the way they leave the surface of the water, and the manner in which they sit upon the water.

The puddle ducks feed in shallow water or dry land, and gather their food by picking the food from the surface of the soil or putting their head down in the water and tipping up to reach the bottom, if the depth of the water demands it. The divers generally feed in deeper water and dive to obtain their food.

When leaving the surface of the water, the puddlers spring quickly from the water and fly up at a sharp angle. The divers leave the surface by "running" along the water using their wings and large feet until they become airborne.

All the divers sit low in the water and hold their tails low, almost touching the surface, while the surface feeders sit much more buoyantly and hold their tails high.

In the surface feeding group are found such ducks as the Mallard, Pintail, Wood Duck, Gadwall, Blue-winged and Gree-winged Teal, Widgeon and Shoveler. The divers include such ducks as the Canvasback, Redhead, Lesser Scaup, Bufflehead, Ring-necked and Ruddy Duck.

Habitat

The surface feeders prefer marshes, grain fields flooded or dry, swamps, rivers, streams, lakes and sounds. The divers, as a general rule, prefer larger bodies of water such as sounds, bays, lakes and larger rivers. Naturally, in the larger bodies of water their respective habitats overlap.

Food

The natural foods of ducks consist mainly of vegetable matter in the form of seeds, leaves,stems and roots of aquatic plants, with a smaller percentage of animal matter. Some of the more choice natural foods are acorns, bulrush, Najas,Potamogetons,smartweed, widgeongrass, and wild millet. The puddle ducks will take many of the cultivated grains, such as Browntop millet, corn, wheat and others.

Place in Conservation Planning

Ducks can be managed in fairly level fields with watertight soils, marshes, or swamps. A choice food submersed under water can be considered as ideal feeding conditions. Water depths should not exceed 15 inches while 2 to 6 inches should be optimum. An assured water supply is needed for flooding. In any area water management is essential.

Introduction

The following information covers the management practices for ducks. It is

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inclusive and covers most situations one would encounter in this state.

Several factors should be explained to an interested landowner before he embarks on a duck habitat improvement project.

1. Even with some of the following management practices established perfectly, it may still take several years before a good population of ducks is built up.

2. Next to water control, shooting pressure is the most important factor to continued duck usage of an area. It is recommended that shooting be restricted to the A.M. only and then only two to three times per week. The number of days hunted will depend on the size of the area in question.

3. Small areas, less than 3 acres, will not receive much use, unless they are fairly close (less than 5 miles) to a large concentration of waterfowl. The exception to this would be a duck field or woodland duck field in a wooded area, which would receive considerable use by wood ducks.

Types Of Areas That Can Be Managed

Level fields - Upland or low-lying level fields can be used to attract and hold ducks if the soil type is one that will hold water.

Around the selected fields a low dike, 2 to 3 feet high, must be thrown up to retain the water used in flooding. This water need not be deeper than 15 inches, because dabblers dislike to feed beyond this depth. If a field has a moderate slope, it may be divided by cross dikes to achieve the desired depths. It can also be flooded in increments, or flooded completely and dropped in increments, so as to utilize all of the field at the proper depth.

In fields such as these, a crop of corn or Browntop millet can be planted and left standing. This is an important point: the grain should not be knocked down or shattered. 1/ If this is done and the field is shot over, it is considered as baiting, and therefore is illegal. These fields should be flooded by mid-October to early November when most of the ducks arrive. If flocks of blackbirds are using the field, it may be flooded earlier to protect the crop. When planting the crop, omit a few rows in the center of the field, or leave small unplanted areas over the area, so that the ducks can use these spaces as a "landing strip". It is also a good idea when planting Browntop millet to throw in a few handfuls of a taller growing crop such as milo or cattail millet. This will provide a little cover which the ducks prefer.

When considering this practice or any of the others that follow, be sure an adequate water supply is present. Do not depend on rain--dry Octobers and Novembers are all too common. The water source can be a stream, river, lake, spring or well. The most desirable way of supplying this water to the field is by gravity flow, but if this cannot be accomplished, the water can be pumped into the field by a low overhead or irrigation pump. An ideal location

1/ Crop fields may also be harvested, flooded, and shot over and it will be legal, provided that the grain was harvested in a normal agricultural manner.

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for a duck field may be below a farm pond. Then a water supply is assured and gravity flow can be utilized.

If the highest level of management is to be used in natural marshy areas, the site selected must be drained and disked. A crop of corn, Browntop or Japanese millet can be planted in these locations. These three cultivated crops and smartweeds have been recommended for duck foods, because they have been proven as choice foods, and because they have the best keeping qualities under water of any duck foods studied. The crop chosen will depend on the depth of drainage obtained. If the water table can be lowered 12 inches or more, corn may be grown. If the water table can be lowered 4 inches or lower during July and August, Browntop millet can be produced. In areas of poor drainage, Japanese millet should be used, but if little drainage can be accomplished, smartweed should be encouraged. Two methods can be employed to favor smartweeds; a spring controlled burn followed by a light disking, or moderate grazing by cattle until July. The cattle will not eat the smartweed because of its acid taste, but will eat the competing plants. They should be removed by July to prevent damage to the smartweed by trampling and nipping of the seed heads. If smartweed is absent in the area, it can be planted with rootstocks at the rate of a dozen plants or so per acre, or seeded at the rate of 20 to 25 pounds per acre. If the seed is planted in the spring, it should be scarified.

Saline and Slightly Saline Marsh Management

If a marsh area has plants which indicate rather strong salinities 10,000 ppm to near sea strength - 36,000 ppm, i.e. smooth cordgrass, saltgrass, sea oxeye, glasswort or pickerelweed, and widgeongrass, it is best managed by water control. This water control should be one that will permit some tidal fluctuation, but yet never allow the marsh to completely dry out. Low level weirs, which should be set approximately 6 inches below marsh level, or flap gates, which can be raised to permit tidal entry, are suitable for this type of management. With this type of control there will always be water in the marsh, so that the aquatics present, primarily widgeongrass, will not be dried out. Yet there will be enough water removed so that some of the more valuable marsh plants (saltmarsh bulrush, Olney bulrush and others) will have suitable conditions for germination. With this fluctuation of water levels there will always be enough water in the marsh for muskrats, nutria and other furbearers and to float the hunters' and trappers' boats.

On a marsh with less salinity, from 10,000 ppm down to fresh water conditions, which is characterized by such plants as marshhay cordgrass, barnyardgrass, sprangletop, Bacopa, Najas, longtom, seashore paspalum and knotgrass, a different form of management is employed. Water control devices are so constructed as to have complete water control. From about June to September the marsh should be kept in a semi-dry condition so that the various grasses, smartweeds and other duck food plants can grow. Yet there should be enough water left in ponds so that the aquatics can survive. The marsh should never have the opportunity to remain completely dry, because it may be in a cat-clay situation where extreme acidity could be produced. Water can be removed by gravity, aided by north winds, or it can be pumped out.

Whenever a marsh problem arises and there are questions confronting the

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district conservationist which he cannot answer, he should request a marsh evaluation to clarify the situation.

Wooded Areas

A flat, low-lying tract of bottomland hardwoods, with a high percentage of oak, ash, and buttonbush can be used for a woodland duck pond. This area must have an assured adequate water supply, so that in the fall the impounded area can be flooded with 2 to 15 inches of water. This type of situation is especially attractive to mallards, wood ducks, and sometimes others. In any type of woodland harvest, the ash, hornbeam, oaks and beech should be favored by the removal of competing trees. This thinning will stimulate the production of mast and food producing plants, and provide landing areas for the ducks. If any opening, such as fields, etc., are within the selected tract, they can be planted to corn and Browntop or Japanese millets, depending upon the drainage. These ponds should be flooded by mid-October or early November and drained by March. Water should not be held later than this, or it will injure the hardwoods present. If any pines are present in the selected area they should be removed because, unlike the hardwoods, they cannot tolerate continuous water flooding.

Farm Ponds

Most farm ponds are not good duck ponds and vice versa, because there is usually a minimum of shallow water present in a good fish pond and no weed growth present. Whereas a duck pond requires shallow water and some food and cover producing plants. However, if a landowner wants to produce duck foods in a pond which has an area that can be flooded to a shallow depth, these are the steps to be taken:

1. Draw the water down in July, a few inches to 2 or 3 feet.

2. As soon as the water is off the flats, broadcast 20 pounds of Japanese millet to the acre. Covering the seed is unnecessary. Apply 500 pounds of 5-10-10 over the seed. If farm machinery can be used on the exposed area, disk and broadcast or drill 200 pounds of Browntop millet per acre. Drag in if seed is broadcasted. Apply 500 pounds of 5-10-10 per acre.

3. Raise the water level in October, either progressively, so as not to flood the planting too deeply, or if the planting is troubled by blackbirds, flood completely and gradually lower the water level during the winter. Try to keep the water over the seed less than 15 inches in depth.

4. If the pond is dependent on rainfall, water may be pumped in from some other source during dry spells.

Beaver Ponds

Beaver ponds in broad flat bottoms offer an opportunity to manage for ducks with a minimum of effort. The secret of success in managing these areas is to keep the beaver from flooding the area after the water has been removed. This practice has been successful 85 percent of the time in other states. This can be done as follows:

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1. Break the beaver dam at one or two places in early July and place a three-log drain in the break.

2. As soon as the pond is drawn down, broadcast Japanese millet on the wet flats, at the rate of 20 pounds per acre, and fertilize at the rate of 500 pounds per acre with 5-10-10.

3. Generally, the beavers do not stop the drain at this season of the year. If they do, reopen it.

4. Remove the three-log drain in early October and let the beavers repair the dam. This will flood the Japanese millet so that the ducks can get it. If the beavers do not repair the dam, the gap can be refilled, beaver-like, by replacing sticks and mud in the opening. See illustration on next page.

Shallow Ponds Managed For Fresh Water Vegetation

This type of pond is difficult and uncertain to manage and should only be planned when there is no alternative method of growing duck foods. Examples of where this type of management can be used are; where wetlands do not have a suitable drainage outlet, or where the topography is unsuited for a duck field.

Wild or native foods that can be tried are aquatic smartweeds, dwarf spike-rush, muskgrass, Najas, pondweeds, and watershield. Seed can be gotten from natural stands or individual plants dug and replanted.

Rice Fields Harvested and Fallow for Ducks

Flood rice fields that have been harvested or have laid fallow for a year or so with 1 to 15 inches of water during late October and early November. Keep these fields flooded until March. Fields away from human disturbance of 10 acres or more seem to attract and hold ducks better. An average of 176 pounds of choice duck foods per acre are found in the harvested fields, whereas an average of 328 pounds per acre of choice duck foods are found on lightly grazed fallow rice fields.

Existing water management facilities for proper rice irrigation is considered adequate to meet minimum biological needs for waterfowl. Therefore, such existing facilities will be an acceptable part of these specifications if biological aspects are applied according to the above specifications.

Nest Boxes

In areas where inadequate nesting sites (tree cavities) prohibit the wood duck from producing its young, nest boxes can be erected to correct this deficiency. Plans for construction of these boxes can be obtained from the SCS biologist or the Louisiana Wild Life and Fisheries Commission.

These boxes may be placed along large streams, rivers, lakes, farm ponds, or swamps. The success of these boxes cannot be predicted. In some places they have been well used; in other areas, very little to no utilization has been

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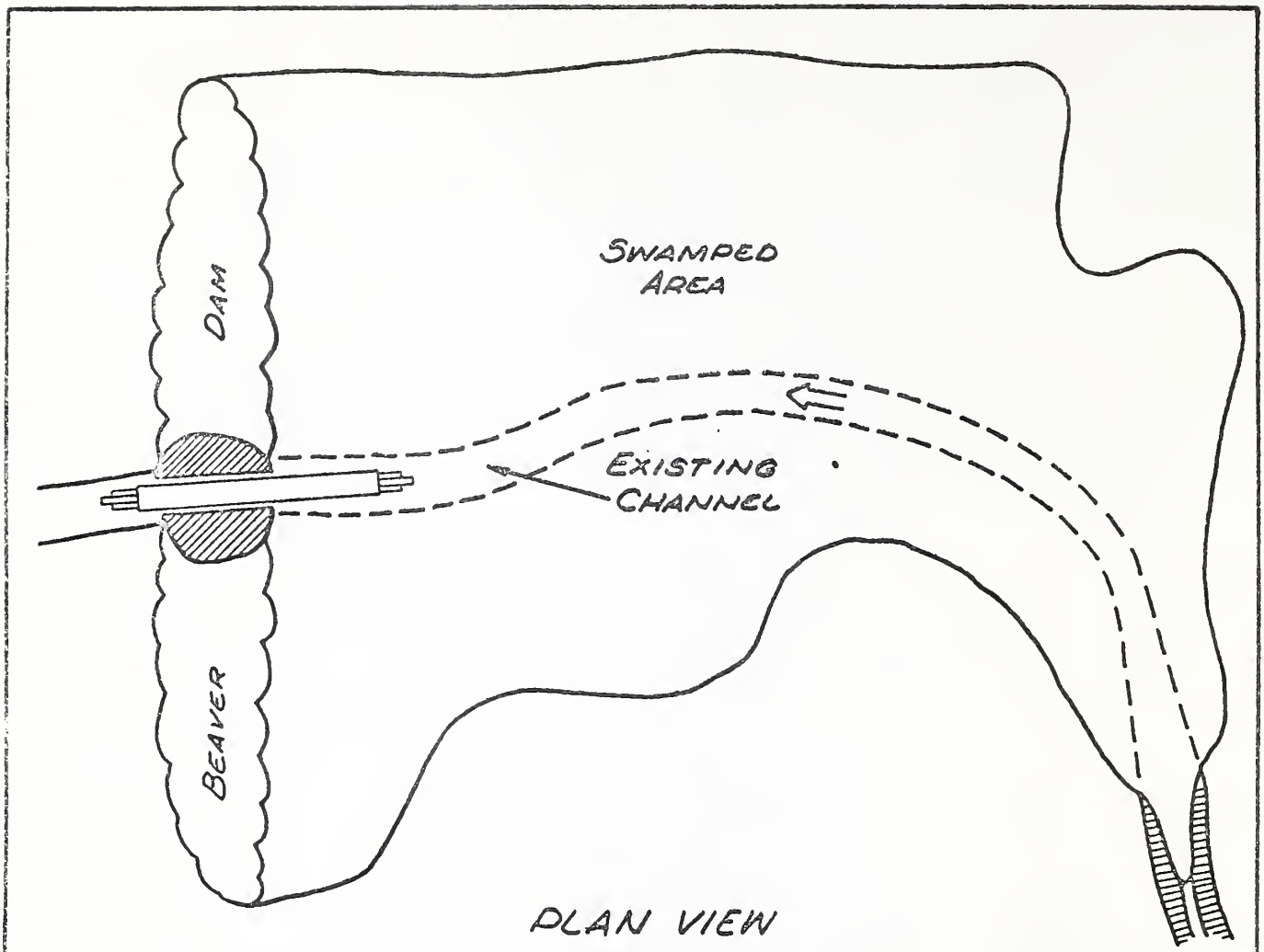

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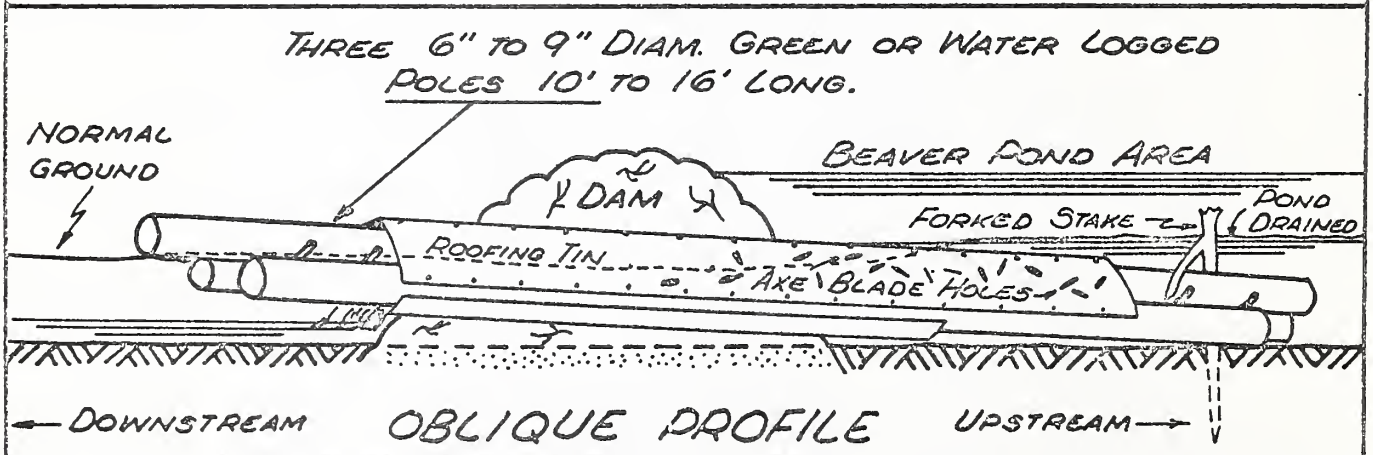

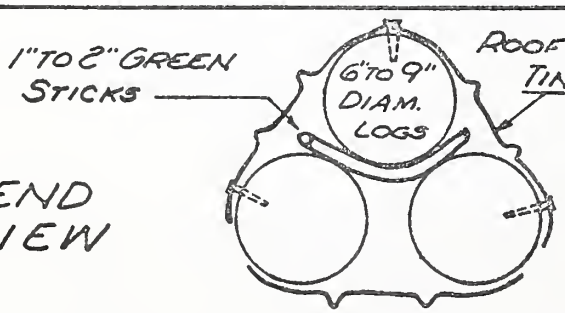

END
VIEW

LOG DRAIN FOR BEAVER DAMS

U.S. DEPT. OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED: D.H. ARNER 7/61	
REVISED D.H. ARNER 7/62	

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reported. Predator proofing these nest boxes is essential, or they will become a "death trap" for nesting hens, or entire clutches of eggs and/or young.

Shallow Fresh Water Ponds and Lakes

If such bodies of water can be drained, drain them and plant them to some of the choice duck foods mentioned earlier. If drainage can be achieved, consult with the SCS biologist for management suggestions.

Reference in Work Unit Offices

"Managing Farm Fields, Wetlands, and Waters for Wild Ducks in the South", USDA Farmer's Bulletin No. 2144.

Louisiana Gulf Coast Marsh Handbook.

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LAND MANAGEMENT FOR GEESE

There are four species of geese which migrate to Louisiana during the winter months. These are the Canada, Lesser snow, white-fronted, and blue. The Canada is definitely in the minority and only one to two thousand continue to winter in Louisiana. These stay mainly at Lacassine Refuge and Gum Cove, south of Sulphur. A few small, scattered flocks are found elsewhere, but these populations are small. Virtually all of the geese in the state winter along the coastal marshes and the rice belt of South Louisiana. All of these geese breed in the far north and have fairly stable population levels. The white-fronted geese arrive in September and the blues and snows in October. Canadas generally arrive in late October to early November. Geese remain in Louisiana through February, with a few stragglers staying on through March.

Habitat

Wintering area - coastal marshes, large open croplands (soybean fields), rice fields, and pastures.

Place in Conservation Planning

Geese can be attracted to the larger, open croplands, pastures and marshes provided they are not molested too much during their initial stay and are afforded adequate food.

Food

All geese that winter in Louisiana are primarily grazers. The white-fronted and Canada take more grain than the blues and snows. All of these geese eat the tender shoots and leaves, as well as the roots and tubers of marsh and wet soil plants. Their favorite foods are: Rice, rice sprouts, three-square or Olney bulrush, saltmarsh bulrush, young shoots of the cordgrasses, annual rye, clovers and any other tender, green vegetation, cultivated or wild, that is available. Geese will land in fields that are dry or slightly flooded.

Management

Planting of winter wheat, ryegrass, clover, rye and other succulent winter annuals are attractive to geese. These should be planted and ready for the geese by late October. Large open fields free of tall vegetation are desirable.

The burning of brackish marsh from September to February favors the production of tender young shoots and clears the ground of heavy rough so that the geese can get to the roots and tubers of marsh grasses. Burning encourages the saltmarsh and Olneyi bulrush, which are a favored goose food. A burn should be made two or three weeks before their arrival. A series of these burns two to three weeks apart can be spread over the winter months to keep tender greens coming along.

Water

Geese drink water daily. Flocks that are feeding in an area void of drinking

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water, or in a salty sight, will fly quite a distance for fresh drinking water.

Reference

Louisiana Gulf Coast Marsh Handbook.

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LAND MANAGEMENT FOR BLACK OR LARGEMOUTH BASS

The largemouth bass, called Black bass in some areas, is highly regarded as a game fish. Fried to a golden brown in cornmeal, he also rates acclaim from the fisherman and nonfisherman. This fish is easily managed when stocked with a suitable forage fish and will produce good poundages per surface acre. Spawning occurs every spring on a gravel or firm bottom when the water temperature reaches 65° to 70°F. About 5,000 to 10,000 eggs are produced, which take seven to ten days to hatch. Even though the eggs are guarded by the male, many eggs and fry are lost to other fish. As the fry become older and the male stops protecting them, they may be eaten by other fish or their own parents. This loss of fry and young fish is continuously taking place until, at the end of the year, only several hundred young bass may remain.

Bass will live in most any warm habitat that is free of excess siltation and pollution. They will tolerate salinities up to 8,000 ppm and thrive and make good growth up to 5,000 ppm, but they do not breed beyond the 2,500 to 3,000 ppm range.

In the Florida parishes of Louisiana, and in a few streams west of the Mississippi, we have another species of bass living in clear, swift, flowing rivers. This is the spotted bass, M. punctulatus, often called the "smallmouth bass". This is a misnomer, because there is another stream and river dwelling bass correctly called the smallmouth bass that lives further north. The spotted bass doesn't attain the weight the largemouth bass does, but does provide a splendid battle on a rod and line. This reduced size is a genic factor, and is not caused by the lack of food. However, much of his food energy is utilized battling the current and staying in his chosen place in the stream or pool.

Place in Conservation Planning

The black bass is an ideal fish for stocking in ponds of one-half acre or larger. In ponds smaller than one-half acre it is difficult to retain the proper balance between the bass and bluegill populations. They will do well in flood detention pools of PL-566 projects too. However, they should be stocked with bluegills or other suitable forage fish which will furnish the bass with adequate food for proper development. A minimum of three feet of water is required.

Food

Bass, when young, feed primarily on insects, crustaceans and other small forms of animal life. As they grow older their diet changes to other smaller fish. However, they will swallow anything they can get into their mouths. Snakes, crawfish, the young of muskrats, squirrels, mice, ducks and birds have all been found in the stomachs of bass.

Habitat

Any warm water pond within the pH range of 5 to 10; salinities below 2,500 ppm and temperature range of 35° to 95°F. There should be some portion of the pond, at least 25 percent, having depths less than 6 feet.

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The largemouth buffalo is a common species of food fish native to Louisiana. It is found in all of the river systems of the State as well as lakes and bayous. Its acceptance as food is varied; in some areas these fish are not used at all, whereas in other sections they are considered delicious. This fish has been grown along with catfish and carp in the fish-crop rotations in Arkansas. Great numbers of these fish have been produced in the past, but recently the trend has been for catfish alone. There are a few people in Louisiana who are growing buffalo, but only in a limited way. The economics of buffalo have not been worked out as yet, but under the present system of production the costs are low and there may be an ample margin of profit. Not enough work has been done to fully explore all of the management practices and possible profits resulting from these measures.

Place in Conservation Planning

Buffalo can be grown in most any pond or lake that has a minimum of 3 feet of water. A water control structure should be present to facilitate harvest.

Type of Ponds and Water Quality

Buffalo can be grown in any type of pond, but one that can be drained by gravity would be preferred. Leveed and impounded ponds are most desirable. The size can be anywhere from a few to over 100 acres, but 2 to 40 acre ponds would be more practical. The depth need not be over 4 feet deep with a minimum depth of $2\frac{1}{2}$ feet. The water source may be a well, spring, or surface water. If a surface source is employed, the water should be filtered to prevent any wild fish from entering the pond. The water requirements for buffalo are about the same as catfish, except they can withstand lower oxygen levels.

Spawning ponds can be small, 1/8 to 1 acre in size and 2.5 to 3 feet deep. They should have water control structures and the incoming water should be filtered.

Management

Spawning - The brood stock should be from 3 to 8 pounds in size and at least two years old. The sexes can be distinguished by the genital opening which is more protruding and redder in the females than the males. Also in the spawning season the male has a gritty or sandpapery feel over the body, whereas the female is uniformly smooth.

The spawning ponds should be small, .25 to 1 acre in size, 2 to 3 feet deep, have a crop of grass on the bottom (grown over the winter, ryegrass is ideal), and be freshly filled. Eight to ten pairs of brood fish per acre are stocked during March and spawning takes place between the temperatures of 58°-70°F. (A Louisiana cooperator says spawning takes place at 58°-62°F whereas Brady and Hulsey in Arkansas state this occurs at 65°-70°F). The egg masses are deposited on submersed grass, twigs, branches, and other debris. Spawning can be prolonged and stimulated by a rapid rise in water level with clean, cold water. If a well is available and has cold water, it can be used for this purpose.

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The egg masses are "robbed" (removed by hand) and placed in a brood pond for hatching. This pond must have a good bloom so that the young fish will have something to eat when they hatch.

Brood ponds can be small, one-half to 5 acres, have an average depth of 3 feet and free of wild fish. Stocking rate for the fingerlings can be 2,000-10,000 per acre.

Production

Production ponds should be larger than spawning or brood ponds; 5 to 200 acres are adequate.

The stocking rate will determine the size of the final product wanted. Arkansas' experience shows these fish can be grown from an egg to 1½ lbs. in a year. However, one Louisiana grower of buffalo states he can grow fish from 4 to 6 lbs. from April until October. These fish are 3 to 6 inches when stocked at the rate of 300 per acre and reached the weight mentioned in 7 months.

Data from an Arkansas grower says stocking at the rate of 500 per acre will yield a one pound fish at the end of the summer. At 250 fish per acre, a 3 pound fish is produced.

Since these fish feed upon bottom dwelling organisms, algae and plant debris, fertilization would greatly stimulate their growth. With fertilization, the stocking rate could theoretically be doubled. The rate of fertilization would be the same as that used in a farm pond. Feeding could increase the stocking rate even more, but at this time not enough is known about the feasibility of this subject and its economics.

Buffalo are harvested by lowering the water level and seining.

Marketing can be door-to-door sales, on-the-farm sales, selling from a specific place, time and date in a town, or possibly dressed fish for restaurants or civic and church groups.

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Minnows are in high demand for fishing bait, especially around the larger reservoirs and lakes. These small fish can be grown readily in this area but do require a moderate amount of labor and capital to be established. The minnow production on a large scale is a highly competative enterprise, and anyone wanting to enter it should study the business carefully. Small operations catering to a local market can produce a modest income and have a better chance of succeeding.

The chief minnow grown in Louisiana is the golden shiner which, according to size, is used for bass or white perch (crappie). It is a soft minnow and bruises easily, and is subjected to fungus infection, so care must be used in its production.

Another minnow acceptable for minnow production is the Fathead. the name Fathead comes from a pod of fat that the male accumulates behind his head during the spawning season. He is a smaller minnow than the shiner and is a little more hearty and therefore easier to handle.

Place in Conservation Planning

Minnows can be grown anywhere in the State where suitable soils and water supply exist. Minnow farms should be placed in an area free of severe flooding, or at least the area should be protected by a levee to keep flood waters out of the ponds.

Water - The water supply, quality, and quantity for minnow production is the same as for catfish farming. See Catfish. Well water is most desirable but should be double aerated to remove most of the nitrogen and carbon dioxide. Excess nitrogen will produce a disease called "popeye" if it isn't removed. Surface water free of pollution can be used, but it must be filtered to keep out wild fish.

Ponds - The leveed pond is preferred while the impounded type is the next choice. The dug pond is not preferred but may be used if it is seinable. For engineering design and details, see Engineering Specifications 378A and B. Pond can range from $\frac{1}{2}$ acre up to 20 acres. The larger ponds are more difficult to handle than smaller ones.

Stocking - Shiners - Use brood stock 6 inches or longer and stock between March 1 and May 1 at the rate of 800 to 1000 per acre. Under similar conditions the female will be larger than the male so don't choose large fish alone. There is no reliable method of sexing this fish.

Fatheads - Use brood stock $2\frac{1}{2}$ inches or larger and stock between February 15 and May 1 at the rate of 1000 per acre.

All brood stock chosen should be free of diseases and parasites. Brood stock bought should be held for a reasonable period of time to be sure they are not diseased or parasitized.

Feeding - Prepared feed can be used, or a fertilization program can be used

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to produce a heavy plankton bloom which is used for food. Use the same formula fertilizer that is used for farm pond but double the rate of application.

Harvest - Can be partial or total, depending on the producers' needs. Drag seines or lift nets are generally used.

Oxygen deficiencies - Minnows, like catfish, require adequate oxygen and care should be exercised to see that they do not suffer from the lack of oxygen. To recharge the oxygen in a pond, see oxygen depletion under catfish.

Spawning - Fatheads spawn when the water temperature reaches 60°-62°F and also continues throughout the summer.

Spawning is accomplished by the use of mats made of spanish moss held together by a "sandwich" of hog wire. These are placed in the water a few inches below the surface of water. The shiners spawn on the top of the mat whereas the fatheads attach their eggs on the bottom. Shiner spawning mats, when full of eggs, are removed to another pond for hatching. The hatching pond must have an algae bloom when the eggs hatch or the young will die. The fathead spawning mats are left in the pond with the adults. The male rubs the eggs with the pad of fat on the top of his head to help them hatch. Hatching without the males is very poor.

Diseases and parasites - Follow the same procedures for these problems as is outlined under Catfish.

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LAND MANAGEMENT FOR MOURNING DOVE

The mourning dove is with us all year long, nesting in most every parish and migrating to, from and through this state during the fall and winter. These birds do not spend all their time during the winter months in one place. Their local travel seems to be governed by food conditions. They are particularly attracted to harvested grain fields.

Nesting and egg laying begin as early as February and lasts into September. However, the success of this long nesting period is low. Only two eggs are laid at one time and their fate is dependent upon the absence of unseasonable cold weather, natural predation, accidents, and strong winds. The eggs are hatched in two weeks, and two weeks later the young leave the nest and the process begins again. Incubation is shared by both sexes. Doves construct a very flimsy nest and it doesn't take much to destroy it. About half of the nesting attempts end in failure. Three or four broods per year are produced in Louisiana most years. About six young reaching maturity per year per pair of nesting doves can be considered average.

Place in Conservation Planning

The mourning dove can be attracted to many areas in Louisiana provided a choice seed crop is present on the ground which is free of heavy vegetation, and adequate surface water is present.

Preferred Habitat

Open grain or weedy fields, with surface water and trees for roosting nearby.

Foods

The dove is essentially a seed eater, and only on rare occasions are animal foods taken. Preferred seeds taken are; Birdeye, Browntopmillet, corn, croton, Cyperus, Paspalum and Panic grass seed, pine mast, polkberry, ragweed, rice, signalgrass, sorghums, soybean, sunflower, teaweed, and wheat. A number of common grasses and weed seeds are also taken, but their use is secondary to the above foods. Some of these are pigweed, barnyardgrass, bristlegrass, crabgrass, junglerice, and rye.

Management

Doves will be attracted to any harvested grain field. They will be inclined to stay longer if there is an abundant food supply and ground conditions are fairly clean and open. They do not scratch for their food, so the ground must be free of heavy, grassy cover.

The best plants for dove food are Browntop or Proso millets. These should be planted in rows and the middles kept clean. A broadcast planting can be used, but the doves will not use it much until the plants fall to the ground and leave open, bare areas. When Browntop or Proso millet is planted for dove food, do not attempt to knock it down or shatter the seed. If this is done, it is considered as baiting and therefore illegal. The landowner should be informed of this fact beforehand. A normal seed harvest by agricultural

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equipment is not baiting although some grain is left on the ground.

Several fields scattered over the farm and shot in rotation will attract and keep more doves. Continuous shooting of a field will soon "burn it out". Do not shoot a small field more than one day a week. Larger fields may be shot twice a week.

Water

Doves require water twice a day and will fly quite a ways to get it. Any body of water will do (ponds, lakes, streams, and river), as long as the bank is not too steep and free of brushy and heavy grass cover. Any pond or stream can be made into attractive drinking places by reworking the banks into a gentle slope and grassing it with a low-growing grass like carpetgrass.

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LAND MANAGEMENT FOR MUSKRATS AND NUTRIA

General

The muskrat and nutria are the two most important furbearers in the state. Data from the Fur Division of the Louisiana Wild Life and Fisheries Commission place the harvest value of these two animals well in excess of a million dollars annually. The annual catch of these two animals during a recent trapping season was 712,117.

After the nutria was introduced and started to spread over the marsh, it was feared by many people that it would drive the native muskrat out of the marsh. However, time has shown that these two animals are compatible and can occupy the same area without apparent conflict. Their selection of food overlaps on some plant species, but generally the nutria feeds on coarser vegetation above the ground, whereas the muskrat takes more of its food below the surface of the ground (roots, rhizomes, etc.). The nutria will also occupy marshes which are unsuited for muskrats.

The muskrat is confined to the coastal marshes of this state, but not the nutria. Nutria can be found over the state wherever water is present for any length of time. Frequently he will live in ditches in housing developments!

Muskrats

The muskrat is an important animal in Louisiana's fur industry. During peak years six to eight million are trapped in this state, which is approximately 50 percent of the Nation's catch. Normal years average two to three million pelts. Nutria production has increased significantly in recent years with annual production now ranging between 1.5 and 2.0 million. These two animals bring approximately $4,000,000 annually to south Louisiana.

Muskrat populations are cyclic in behavior. These cycles range from 10 to 14 years between peaks of abundance. Hurricanes, droughts, fires, salinities, and average rainfall all affect the growth of the muskrat's prime foods, Olneys and saltmarsh bulrush, Scirpus olneyi and robustus. When these plants become abundant the population will build up until it becomes so abundant that all of these plants are destroyed. This is called an "eatout". When this occurs, the muskrats either starve to death, leave the area, or are removed by predators.

Muskrats are aquatic rodents weighing between 1.8 and 2.3 pounds as adults. They are approximately 22 inches long and have tails averaging 10 inches. The soft under fur ranges from soft gray-silver to dark brown nearly black. It is covered with coarse long guard hair. When these guard hairs are plucked, muskrat is called "Hudsonseal" which is a trade name. Pelts are usually divided into bellies, sides, and backs and three different coats are produced from about 90 adult muskrats.

The average litter size in Louisiana is 3.7 young, and 5 to 6 litters are produced annually, although 7 or 8 have been recorded. The gestation period is 26 to 28 days. Within 5 to 10 days after giving birth to a litter the female is capable of breeding again.

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Muskrats live either in burrows made in any high ground available or in houses built in the marsh. These houses are made of available plant material (stems, leaves and roots) and are roughly hemispherical in shape. They are 3 to 6 feet in diameter and 2 to 4 feet high. The best houses are made of bulrushes and marshhay cordgrass.

As mentioned before, the muskrat population varies widely. At times populations of 20 to 30 muskrats per acre have been recorded during peaks of the cycle and normal catches are three to four "rats" per house. Other times few or no muskrats may be present in an area.

Nutria

In 1937 the nutria was introduced into the Louisiana marshes at Avery Island. The animal, a native of Argentina, resembles a beaver, except it has a round tail instead of a flat one.

The nutria is quite vocal, giving rise to many strange sounds that are often heard in the marsh. The nutria is more active during the day than the muskrat, and can be seen feeding or swimming anytime during the daylight hours.

The overall length of the nutria is about 25 inches for adults, with 16 inches of this being tail. The tail is furred near the base, but essentially naked towards the tip. Nutria weigh between 9 to 18 pounds and their color is quite similar to that of a muskrat.

The females produce two litters per year, with a 127 to 132 day gestation period. The litters number between two to nine. The males are larger and wider than the female.

Nutria are exceptions in the animal world in that the females have their mammillary glands on their back instead of their abdomen. These are found about two inches below the backbone. This allows the young to nurse while the female swims.

Nutria dig burrows in canals and ditch banks, and also make feeding rafts in the marsh.

Place in Conservation Planning

The planning for muskrats and nutria is concentrated in the marsh resource area where suitable habitat can be managed. Controlled burning, level ditches, and water control are the most important.

Food

The chief foods of the muskrat are Olney and saltmarsh bulrush, paille fine, cattails, common reed, delta duck potato, marshhay cordgrass, arrowhead and giant cordgrass. Animal matter constitutes about 5 percent of the diet and includes crabs, crawfish mussels, and small fish.

Management and Harvest

For details on these two items see Section 4.7 to 4.11 of the Gulf Coast Marsh Handbook.

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LAND MANAGEMENT FOR NONGAME BIRDS

Birds are becoming increasingly important from an aesthetic standpoint these days. More and more people who are living in Suburbia are interested in birds because they are one of the few forms of wildlife that will live close to man which are readily observable. Their beauty, graceful flight, melodious songs and amusing antics provide many hours of pleasure for people living in small towns and suburban housing developments.

Their value on the farm, eating weed seeds and insects, still can't be underestimated, even though these duties have been taken over by herbicides and insecticides. Annually the birds inhabiting farmland still do carry out an impressive control of insects and weed pests.

The pastime of bird watching has become a pleasant activity for several million people in the U.S.A. These people, "Birders", they call themselves, will travel long distances and spend considerable sums of money to see new and different birds. In fact, several large tracts of land in the eastern United States have been planned to be attractive to birds, just so people can see them. The SCS in several states has also worked closely with the National Audubon Society in planning some of their bird refuges, and have done similar planning for individuals that are interested in birds.

Place in Conservation Planning

Birds can be attracted to most every conceivable situation; fields, woods, marshes, swamps, or house lots. The provision of food, water and cover is necessary to retain them.

Food - Food is perhaps the most important element in a bird's life. The vitality of the species, energy to escape and withstand the hardships of life and reproduce, is dependent on proper amounts and kinds of food. Food provides the heat to withstand the rains, snows, and low temperature of winter. Food gives health and strength to resist and overcome disease. Young birds grow to maturity only if they receive enough food to supply their growing needs.

Birds eat a wide variety of foods; seeds, acorns, nuts, berries, fruits, insects and their larva, worms and small invertibrates. Many birds go through a feast or famine period when they depend on naturally available foods. Therefore, to manage for birds, the landowner should provide choice foods in dependable quantities so as to fulfill the year-round requirements.

Plantings to attract birds of various species can be composed of: autumn olive, beautyberry, black and blueberries, dogwood, elderberries, grapes, honeysuckle, hollies, privets, photinia, pyracantha, smooth sumac, laurel cherry, viburnums, Virginia creeper and other fruiting vines and shrubs. Try to select a group of plants which ripen their fruit at different times of the year, so as to prolong the food supply. A food supply over the critical winter months is one of the most important items if a person wants birds around his home then. Many annual grasses, such as panics and paspalums, are also choice food for seed eaters.

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Artificial Feeding - Anyone interested in attracting birds can do so by using feeders around the house. These are especially valuable during the winter. Feeders bring birds in close so that they can be seen and enjoyed. Several feeders are usually better than one, because certain birds tend to drive the others away.

To protect birds from cold winter winds and storms, place the feeders on the south and southeastern side of the house or put them in an evergreen thicket. Place the feeder near some form of cover and keep it full, so that birds have feed available at all times.

The table below lists common birds and the foods attractive to them:

Woodpeckers, flickers - - - - - - -	Suet, cracked nuts, corn.
Jays - - - - - - - - - - - - - - - -	Suet, cracked nuts, bread
Titmice, chickadees, nuthatches --	Suet, cracked nuts, shelled and broken peanuts, sunflower seed, bread crumbs.
Mockingbirds, thrashers, blue-birds, robins - - - - - - - - - - -	Cut apples, currants, raisins, bread crumbs.
Blackbirds, cardinals, towhees- --	Sunflower seeds, corn, peanut butter, nutmeats.
Juncos, finches, native sparrows--	Millet, wheat, small seed mixes, bread crumbs.

Cover - As mentioned previously, the wider the spectrum of plant life present, the greater the diversity of birds present. When planting for cover, use a plant that will also provide food as well. If a particular species is wanted, try to duplicate the cover requirements of that bird. By consulting books on birds, such as those listed under references, one can usually obtain this information. When working with urban people or developers, have them maintain as much of the native vegetation as possible when clearing land for housing developments. Sound trees with hollows should be spared. Bird houses can be placed around homes to attract birds if such hollows are absent.

Water - Many birds live around water and all require it daily, so if some water is available it will be used by birds. A small stream, pond, marsh, or just a bird bath with a trickle of water coming into it will attract many species of birds.

If any particular problem arises concerning birds and their attraction, consult with your state biologist.

References:

Davison, V. E. - Attracting Birds from the Prairies to the Atlantic, 1967

Lowery, G. H. - Louisiana Birds, 1960

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LAND MANAGEMENT FOR RABBITS

General

Louisiana has two species of rabbits, the cottontail, found primarily in the uplands, and the swamp rabbit, found in bottomlands, swamps, and marsh. In some areas their ranges overlap. The cottontail is most abundant around agricultural lands, whereas the swamp rabbit is primarily a woodland or marsh dwelling creature.

Rabbits can be found breeding at any time of the year. However, most of the breeding takes place from February through August. Three to five litters are born each year and between three and four would be an average size litter. The young are raised in a shallow depression (nest) dug in the ground. It is lined with leaves, grass and fur plucked from the breast of the female. The gestation period is about one month,and three to five litters are born during a year. Maternal care covers a period of 15 to 18 days, after which the young can care for themselves.

A rabbit that lives to be over a year old is lucky. The average life expectancy is 4 to 6 months. Seventy percent or more of the fall population are young of the year.

Place in Conservation Planning

Management practices can be planned in open, brushy, or wooded situations. Brushy areas in the uplands, especially around croplands, should receive consideration for cottontails. Swamp rabbit management should be initiated in the bottomland handwoods with scattered openings.

Habitat Needs

Food - The year-round diet of the rabbit includes a large number of plant species of grasses, forbs, and woody vegetation. Summer foods consist of grasses, low broadleafed weeds, and many agricultural crops, especially the legumes. Winter foods will consist of available greens, buds, twigs, and bark. Choice food for the rabbits are clovers and tender grasses.

Cover - Tall grasses, blackberry and greenbrier patches, honeysuckle thickets, young pine plantations, brushy cutover woodlands, or rank herbaceous vegetation provide all the cover that rabbits need. Brush piles placed in woodland and along the edges of fields are a favored hiding place. Multiflora rose planted as a fence row or in small patches provides excellent cover.

Water - Rabbits drink surface water when it is available but it is not essential. Apparently dew, succulent vegetation, and moist foods furnish the required moisture.

Management

Food - If food is lacking, small patches, 1/10 to 1/8 acre in size, of a choice food can be planted near suitable cover. Food plantings should be adjacent to protective cover. Some of the more choice foods are; clovers, winter wheat,

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rye, ryegrass, fescue, alfalfa, Sericea lespedeza, soybeans, and tender grasses. To make these most attractive, they should be well limed and fertilized. Establish these plantings within 150 feet of cover.

One-eighth acre of food plots per 5 to 7 acres is adequate.

Cover - If natural cover is absent, planting of Sericea lespedeza or multiflora can be made. The Sericea can be planted in strips 1/8 to 1/4 acre in size or as small "spot" plantings scattered over the area. Plantings of Sericea lespedeza and lovegrass are highly attractive to rabbits. Use about 1/2 pound of lovegrass seed per 20 to 30 pounds of Sericea seed.

Multiflora can be planted as a double row (one foot apart in the rows and one to two feet below rows), and used as a living fence or planted in clumps or small squares or circles. The latter can be scattered over open fields.

Normal timber harvest in bottomlands will do much to increase swamp rabbits. Small food plantings in openings will also be well used by these woodland rabbits.

Brush piles are attractive to both cottontails and the swamp rabbit. Make these 15 feet to 17 feet in diameter and 6 feet to 8 feet in height. Use hardwood brush for these as it lasts longer.

Thick, rank growth of grasses, weeds, or brush should have strips mowed through them to break this cover into a more desirable pattern. These strips should be mowed every second or third year to produce different age groups within the broken cover type.

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The common snipe (Capella gallinago) and formerly called the Wilson or Jack snipe, is a resident of Louisiana from late fall to early spring. During the early spring (depending on temperatures) this bird leaves Louisiana and migrates north to breed, traveling as far as Greenland and the Arctic Circle for his nesting site. Usually, during the late summer and early fall, he starts his flight south and may arrive as early as August, or as late as November.

The snipe is a camouflaged masterpiece. The varying shades of brown, tan, and black blend perfectly into the dead vegetation of the winter fields. He is one of the most difficult targets a wing shooter could ask for, flying with a zigzag path which baffles even the best of shots.

He is frequently confused with the woodcock by the laymen, but the snipe stays in open areas whereas the woodcock lurks in brushy or wooded areas.

His favored habitat is cropland, pastures, or sparsely vegetated areas in marshland, which are shallowly flooded to a "puddled" condition. It is in these places that he probes with his two-and-one-half-inch bill for earthworms, the larval forms of insects, and crustaceans.

Shallowly flooded (1 inch to 2 inches deep) rice fields and pastures attract thousands of these small birds each winter. Any wet crop field is also attractive along with the edges of ponds or sparsely covered marshes.

Place in Conservation Planning

Snipe can be managed in low-lying fields that are fairly level and capable of being flooded, (not more than 1 or 2 inches deep) or to a "puddled" condition.

Management

To manage a field for snipe, it must meet the following requirements:

The field should be level (less than 1 percent slope), the soils should be watertight and there must be an assured water supply present for flooding.

A low levee should be constructed around the field and a water control structure included in the levee system, so that the area can be flooded and drained.

A crop of grass (fescue, bahia, ryegrass, etc.) or other herbaceous vegetation can be grown, or native vegetation can be allowed to vegetate the field. This vegetation can be worked into the soil by disking, plowing, or with a rotary chopper. The chopper works best. This should be done in late September or October.

In November flood the field with not more than 1 to 2 inches of water. The earthworms, larval insects and other invertebrates, which will be living on the decomposing vegetative material, will be forced by the flood waters into the clods and lumps of soil above the flooded zone. Then the snipe can probe these clods for these creatures, which comprise the bulk of their diet.

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LAND MANAGEMENT FOR SQUIRRELS

General

The squirrel is considered as the number two game animal in the Nation. Only the rabbit outranks him. Both the Gray or Cat squirrel and the Fox squirrel are found throughout the State. Generally, the gray squirrel is found in bottomland hardwood forests, and the fox squirrel is found in the uplands. An exception to this is the delta fox squirrel which lives in the Mississippi bottomlands and may or may not share this area with the gray squirrel.

The population levels vary from year to year and are dependent on the mast crop of trees. Following several good mast crop years the squirrel population will be high. Several years with little or no mast crop will mean few or no squirrels in an area. These small animals will move to a food supply.

Two squirrels per acre is considered a high population, whereas one per three or four acres is nearer average.

There are two breeding seasons per year. The first is in December to March and the second is from late June to August. Gestation period is 6 weeks. Therefore, litters are usually produced in March and August. However, breeding can occur at any time of the year. Adult females may (depending on food supplies) produce two litters per year. Litter size varies from two to six, with three as an average. Maternal care covers a period of about 12 weeks, after which the young are able to care for themselves.

The potential life span of a wild squirrel is six or seven years, but few, if any, ever reach that age in the wild. About sixty percent of the fall population is usually young of the year.

Place in Conservation Planning

Gray squirrels are animals of larger blocks of timber than the fox squirrel, so any management for them should be directed to such areas. Fox squirrels can live in more open woodland and especially like small blocks of timber mixed with cropland, or scattered hardwoods in pine areas.

Habitat Needs:

Food - The gray squirrel depends upon a wide variety of natural foods, especially hardwood trees and shrubs. Choice native foods for fall and winter are baldcypress, beachnuts, blackgum, chinkapin, flowering dogwood, hickory nuts, blue beech, magnolia, oaks (acorns), pecan, pines, tupelo and walnut. Choice native foods for spring and summer are blackberry, cottonwood (cambium and buds), black cherry, elm (seed and buds), grape, huckleberry, red and other maples (seed and buds), mulberry, mushrooms, Osage orange, and pines. Squirrels also eat a wide variety of less important foods such as herbs, mushrooms, insects, roots, etc. Choice foods for feeding stations in yards are bread, cantaloupe seed, corn, pecans, grain sorghum, sunflower seed, and wheat.

Cover - The gray and delta fox squirrels prefer big tracts of mast-bearing hardwoods with understories of smaller trees and shrubs. These hardwoods should be dense enough that squirrels can travel easily through their crowns.

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This animal has two distinct homes: long-term tree dens and temporary leaf nests. Tree dens are preferred because they afford more protection from weather, natural enemies, and hunters. Dens with openings 3 to 5 inches in diameter and 20 feet or more above the ground are best. Favored dens are 6 or 7 inches wide and 1 to 3 feet deep.

The fox squirrel will live in more open upland situations and prefers a mixture of pine and hardwoods.

Water - The gray squirrel can live for several weeks without drinking water with no apparent ill effects, but free water is an attractive feature of squirrel habitat. In fact, squirrels may leave an area if free water is not available.

Management:

Food - On each acre of woodland leave either (1) five or more mast-producing oaks and/or hickories with diameters of at least 22 inches, or (2) ten or more mast-producing oaks and/or hickories with diameters of 16 to 22 inches. Mast trees should not be crowded by other trees. To lessen the chance of mast failure, leave several different species of oaks and hickories; oaks should be from both the red oak and the white oak groups. Then if one species fails, others will likely produce. Favor mast-producing hardwoods in bottomlands, if possible. For squirrel management leave groups of hardwoods scattered throughout upland pines and preserve understory species such as dogwood and huckleberry. Remove free-ranging hogs and cattle that compete with squirrels for food. Five to ten percent hardwood trees planted with pines will eventually produce enough food to maintain squirrels. Species to plant are hickories, mulberries, oaks--especially the sawtooth, pecan and walnut. Oaks should be planted in groups rather than scattered throughout the pines.

The Chinese chestnut is a highly favored food and one that is quick bearing (four years). However, it needs a fairly well drained and fertile site. A few rows of corn, either left unharvested or shocked, near woodland attracts squirrels from long distances. Chufas and peanuts are also good for field planting. The delta fox squirrel will also take soybeans. Hedgerows of Osage orange and other food-producing species like mulberry and cherry can be established along fences.

Cover - Leave four or five well-distributed, suitable den trees on each acre of woodland. If possible, select den trees that also provide food. In young mast-producing stands where dens are scarce or absent, nest boxes may be erected to relieve the housing shortage. Typical nest boxes are about 2 feet deep and 8 inches square, with entrance holes near the top and 3 inches in diameter. When building nest boxes, make provision for removing either the top or bottom for periodic cleaning. Place nest boxes 20 to 30 feet above the ground, preferably in trees that are at least 10 inches in diameter. Entrance holes in nest boxes should be near the trunk for easy entrance.

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I. Water Quality and Its Chemical and Physical Properties

A. Chemical Properties

Water is called the "Universal Solvent" because most elements are soluble in it to a certain degree. With this property in mind, one can see that water can contain a wide range of gaseous and solid materials. This collection of various elements will give water its individual chemistry.

The pH of water effects all forms of life living within it. Considering most of the fish in the Nation, the liveable pH range probably runs from 3 to 12. However, the fish Soil Conservation Service personnel will be working with will live within the pH range of 4.6 to 11. This optimum pH range for fishery production is from 7 to 9. This includes bass, bluegills, buffalo, minnows, and catfish. In this state, at this time, the extreme pH levels encountered by the state biologist in ponds and ground water have a range from 4 to 10.5. Needless to say, the ponds at the extremes did not contain fish.

Iron is found frequently as a mineral suspended in ground water. Some ground waters are highly charged with it. If water with a high concentration of iron is to be used for fish production, it should either be (1) run down a ditch or canal for 150-250 feet to precipitate it out or (2) let it stand in a pond a day or so until it settles out. The iron in ground water is in a ferrous state; on contact with the oxygen of the air and in the water it changes to ferric and settles out as a ferric oxide.

A gas that is sometimes found in ground and surface waters, especially at or near the bottom of ponds, is hydrogen sulfide. This gas can be eliminated from ground water by aeration. In pond waters it can be removed by recirculation of the water (and subsequent aeration) or by the addition of potassium permanganate. This gas is toxic to catfish, especially to fingerlings, if the water is on the acid side. However, the higher the pH level, the less toxic it becomes. Addition of ground agricultural limestone will elevate the pH for this purpose. See the section under fertilization.

Two other gases frequently found in ground waters are carbon dioxide and nitrogen. In higher concentrations both are detrimental to fish production. In minnows a disease called "popeye", and in catfish the "bends", are caused by high nitrogen concentrations. With adequate oxygen, 15 ppm of carbon dioxide can be tolerated. However, 25-30 ppm will be toxic. Both gases can be removed by aeration. For minnow production double aeration is best.

Hardness is a measurement of the relative amounts of calcium, magnesium and other metals in water. These elements are necessary in water and, in moderation, desirable for fishery production. The absence of these elements is termed softness. All the ponds in the delta,

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prairies, marshes, bottomlands, and much of the Florida parishes will have adequately hard water for fish production. However, in the sandhill areas and tertiary uplands, the water may require the addition of lime to become hard enough to be desirable for fish production. A pH test will give you an indication of the lack of calcium and magnesium in water.

Pollution of surface water and, in some cases, ground water is difficult to detect. Industrial and food processing wastes, mineral exploitation, nitrates and insecticides frequently will make surface water unfit for fishery production. To detect some of these materials in water requires elaborate chemical analysis, which is not readily available to work unit or state office personnel.

As a guide in the use of water for ponds, check on the body of water from which it is taken. If fish are present, it can be considered safe for use. If, in the event of fish being absent for some reason, other aquatic life such as frogs, turtles, snakes, crawfish, and fresh water clams can be used as a criterion.

Insecticides are very toxic to fish in very small amounts. The toxic level of many of these chemicals is figured in parts per billion. On the other hand, relatively few herbicides are toxic. See the section on pesticides under Fish Kills.

Salt can be considered as a pollutant when it comes from oil field production. However, in the coastal areas salt is a natural element occurring in varying degrees, depending on the nearness of the body of water to the Gulf.

Salt, slowly added to water, will not kill fish provided you do not exceed the lethal limit for that species.

Bass and bluegill will tolerate salinities up to 8000 ppm, do well in 5000 ppm and will reproduce below 2300 ppm. Channel catfish have been found living in the wild in water that contained 11,400 ppm. They have been raised in water that ranged between 900 and 11,000 ppm, with an average of 2,500 ppm.

So, salt isn't too detrimental where it occurs naturally. However, when introduced into a fresh water stream, it can be toxic to fish because (1) it may be over the lethal level that fish can tolerate (an average for oil well brines would be 50,000 ppm), and (2) it comes in large "slugs" down the stream and kills all of the fresh water crustaceans and invertebrates that fish feed on.

Oxygen is another gas that is usually found in surface waters. It is generally absent from ground water. Twenty-one percent of the air is oxygen, and when air and water are mixed, oxygen diffuses into the water. Air-water contact, without agitation, introduces very little oxygen into water. The mixing of air and water by wave action, or the splashing of deliberate aeration, is one of the most important ways oxygen is added to water. During these processes, air is trapped and

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forced into the water. Then it comes to the surface as bubbles. During its brief stay below the surface, oxygen diffuses into the surrounding water. Splashing of water breaks it into small droplets which fly through the air. During this trip oxygen is absorbed by the droplet.

The second important source of oxygen for a pond is the photosynthetic activity of plant life in a pond. All plants, big or small, remove carbon dioxide and mineral elements from the water and in their chlorophyll cells convert these elements, with the sunlight as a power source, to a simple sugar. A by-product of this food manufacturing process is oxygen, which is liberated into the surrounding water.

The solubility of oxygen is going to be dependent on the temperature of the water. The colder it is, the more oxygen water will absorb. As an example, water at 32°F will hold 14.62 ppm, at 59°F it only holds 10.15 ppm but at 86°F the saturation point is reached at 7.63 ppm. Higher temperatures contain even less.

Oxygen is continuously being removed. Animals respire it and exhale carbon dioxide. Bacteria use oxygen when they decompose organic matter and even plants use it when they "burn" sugar for energy. At night oxygen is being continuously removed and at dawn it is at its lowest point. After the sun rises, usually a breeze will spring up and cause wave action. With the advent of sunrise the small plants in water (phytoplankton) will start to photosynthesize and liberate oxygen. After sunrise the oxygen content starts to go up and reaches its peak sometime in the afternoon.

The carbon dioxide level in water is inverse to the oxygen cycle. This is caused by: (1) when the sun rises carbon dioxide is used by phytoplankton in food manufacture, becoming the least abundant in late afternoon, (2) when the sun sets the phytoplankton stop their food manufacturing and the carbon dioxide demand stops. Then during the night animal and plant life use oxygen and animals expel carbon dioxide. The level is built up until dawn when it reaches its highest point.

Coincidentally with the oxygen-carbon dioxide cycle is the pH cycle. At dawn the pH is lowest. This is because the carbon dioxide is highest at this time, and carbon dioxide plus water equals carbonic acid. As the sun rises and photosynthesis starts, the carbon dioxide content of the water starts to drop, and about mid-afternoon the pH level is at its highest. The reverse process takes place at dark. This daily pH fluctuation may only be a few points or several points, depending on the chemical makeup of the water, amount of sunshine present, and other factors.

Graphically, this can be shown as on the following chart (not drawn to scale):

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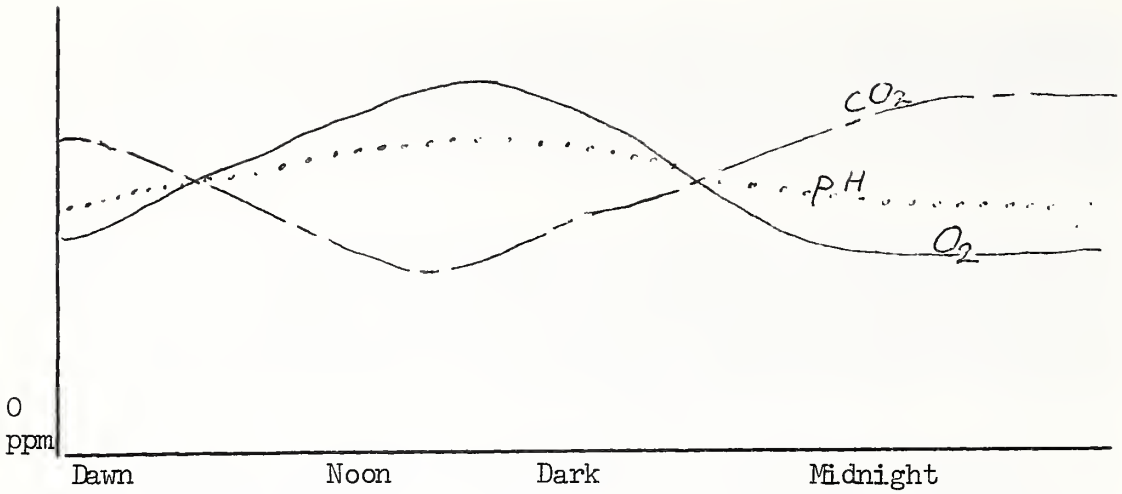

B. Physical Properties

There are two physical conditions of water that work unit personnel should recognize as important; muddiness and stratification.

1. Muddiness is caused by: (1) silt or clay particles being washed into the pond from its watershed; (2) a lake, built in a clay soil, that is subjected to a strong wind sweep, or (3) mud being stirred up by fish such as carp, goldfish, or bullheads. Muddiness is detrimental to fish production because it cuts out sunlight that is needed by the phytoplankton for photosynthesis and in some instances it will cover fish eggs and smother them. As a consequence of the latter event, the hatching success of the eggs may be very poor or none at all.

   Persistant muddiness is caused by the micelles of clay being negatively charged and repelling one another when they come in contact, hence they remain suspended. If some of these micelles or aggregations of some other material could be positively charged, they would be attracted to and by the clay micelles, and eventually become heavy enough to flocculate out. To cause this flocculation to take place, three courses of action are open: (1) add 100 to 600 lbs. of agricultural gypsum per acre, (2) scatter several bales of chopped hay per acre over the pond's surface, or (3) add 75 lbs. per acre of superphosphate. Ordinary fertilization may sometimes clear up a pond that is muddy.

   To prevent further muddying of the water, three things can be done: (1) if the silt load is coming from within the boundaries of the farm, vegetate these areas, (2) if the water source comes from off the watershed, divert the muddy water around the pond via a ditch or terrace, and (3) if fish are causing the turbidity, remove these by the use of fish toxicants.

2. Stratification, the second physical condition that will affect fishery production, is caused by the sun heating up the surface layer of water and causing it to become "separated" from the bottom

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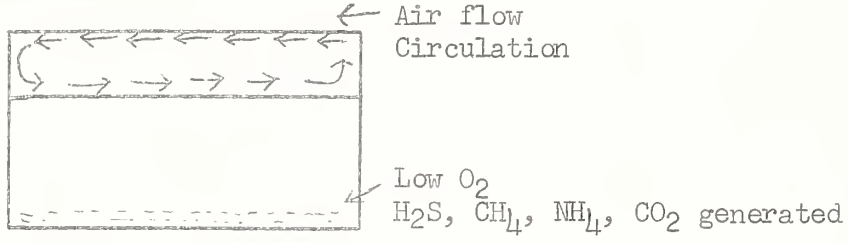
waters of the pond. This condition is most likely to occur in ponds with small surface areas in relation to their volume, or for a pond to be in a hollow and surrounded by woodland. Dug ponds, 8 to 15 feet deep, are examples of the type which stratify intensely. Conversely, a 20-acre catfish pond 4 feet deep, out in the open and subjected to the wind, may not stratify at all, or only weakly if it does.

Stratification starts in the spring when the water starts to warm up. Prior to this time the temperature on the top has been within several degrees to that temperature on the bottom. As the sun warms up the top water, it becomes lighter as opposed to the colder, heavier bottom water. Water becomes heaviest at 39°F (4°C). Eventually, as this warming continues, these two bodies of water do not mix unless forced. The condition is similar to mixing motor oil and gasoline. You can pour gasoline on oil in a can and they won't mix unless you shake them. They have different specific gravities, as the scientists say.

After the segregation of these two bodies of water is complete, the top water, which is rich in oxygen, doesn't mix with the bottom waters. So, the deeper waters are not recharged with this gas, which is being constantly used by bacterial and animal life in the lower reaches of the pond. As the season progresses, the oxygen level of the bottom waters continues to fall. In some cases the oxygen level will reach zero for a large volume of bottom water.

As the oxygen disappears another reaction takes place. Bacteria, which can only live in the absence of oxygen (anaerobic bacteria) take over the job of decomposing organic matter which is constantly falling to the pond's bottom. These bacteria produce, as a by-product of their decomposition, gases such as hydrogen sulfide (H_2S), methane (CH_4), carbon dioxide (CO_2) carbon monoxide (CO) and ammonia (NH_4). Soon the bottom waters are charged with these toxic gases and void of oxygen. These waters are now unfit for fish life.

This condition usually occurs during the summer and early fall. As fall progresses, the top water cools off and soon the specific gravity of the top water approaches that of the bottom water. When this water reaches the proper specific gravity, mixing occurs. This mixing slowly brings some of these noxious gases to the surface where they are released. However, part of these gases are neutralized by the oxygen in the top water as these two layers mix.



During early winter the circulation of a pond's waters is complete and oxygen is again available in the bottom waters.

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Stratification has several deleterious effects on fish production. First, it removes a large volume of water from production because it is void of oxygen and contains many gases toxic to fish. Secondly, in the event of a turnover, a fish kill can take place, which can be complete if conditions are right. A turnover is a condition which forces mixing of the top and bottom waters. This can occur in two ways. If an intense, cold rain falls it may build up a layer of colder water on the warm top water. If this layer becomes heavy enough, it will sink through the warm water and break up the stratification.

The second cause of a turnover is a strong wind, especially if it is parallel to the long axis of the pond. The wind pushes up the warmer water to one end of the pond and, if the wind piles up enough water, the pond will "flip" over. This throws the fish in water without oxygen and charged with the toxic gases previously mentioned.

II. Pond Construction

The Engineering Standard and Specifications and Plant Sciences Standard and Specifications - Pond (378), give all the details necessary for the construction of ponds. The discussion here covers the reasons for some of those requirements.

A. Type of Ponds

For fish production the impounded and leveed ponds are the most desirable. The dug pond is the least desirable. The reasons for this are, (1) dug ponds cannot be drained except by pumping, which is time consuming and expensive, (2) dug ponds cost more per acre foot of water produced than either of the others mentioned, (3) dug ponds, especially the deeper ones, tend to stratify more intensely, and (4) these ponds do not usually maintain a balanced bass and bluegill population. This is believed to be caused by intense stratification and a small area of shallow water.

A dug pond can be used as a fishout pond for catfish as well as any of the other types mentioned.

If an excavated pond was dug shallow and wide (provided the water table was high enough), instead of narrow and deep, it might produce balanced populations of bass and bluegills. However, it still would not be drainable except by pumping.

Water control structures are necessary to fish production because: (1) they are needed to lower the water level for population control, (2) they are used to control the water level for weed control, and (3) it may be necessary to lower the water for levee or dam repair.

Water control structures that take the water from the bottom have several advantages, (1) the removal of the bottom waters keeps down the amount of toxic gases present in that area of the pond, (2) since fertilizer is used by the plant faction of the plankton in the upper

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waters of the pond, the fertilizer will not go out the drainpipe, and (3) ponds equipped with these types of water control structures warm up earlier in the spring and stay warmer earlier in the fall.

Depth of a fish pond in this state need not be over 6 feet. If the pond is a leveed type, 4 feet is adequate. The minimum depth of 24 inches is needed to reduce the possibility of aquatic weed pests invading the pond.

It is helpful in fish management to have a pond bottom free of stumps and other debris so that seining can be done. All such debris should be removed down to the 5 ft. depth.

Spillways in impounded ponds should be wide enough to let the water out in a thin layer. This prevents fish from leaving the pond and wild fish from entering the pond. In the event that a wide spillway can't be constructed, a 2-foot drop can be incorporated on the downstream side of the spillway. This will prevent wild fish from entering the pond.

III. Stocking

One of the first things to be done before a pond is stocked is to see that there are no "wild" fish present. This applies to a new pond that has been built and filled for a while, as well as renovation of old ponds. To make the job of eradication most effective and to reduce cost, the pond should be drained completely or as low as possible. If the pond can't be lowered or drained, there is a strong probability that fish can escape the rotenone.

Rotenone should be applied in September or October, after the bluegills have stopped spawning. Either the liquid formulation or the powdered form can be used. It should be applied at the rate of 3 pounds or 3 pints per acre foot. Treat all water left in the bottom of the pond.

If a pond can't be lowered, additional effort should be made to get the rotenone in the lower layer of water. Remember, these ponds will still be stratified during this time. Applying rotenone in the wake of an outboard motor is a good practice which aids in distribution of this chemical.

In some cases, to insure a good kill, rotenone and antimycin have been mixed to produce some very lethal results.

Soil Conservation Service policy now states that fish killed with rotenone or antimycin should not be eaten. Both of these chemicals have been cleared by the F.D.A. for use in waters where fish are grown.

The best fish for stocking ponds for sports fishing are largemouth bass, bluegills, (with or without 10-30 percent of redear sunfish) and channel catfish. For commercial production, the species to use are channel catfish, minnows (shiners or fatheads), and buffalo.

Ponds from one-fourth acre up can be used for channel catfish. Bass and

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bluegills, with or without the channel catfish, should not be stocked in ponds less than one-half acre in size. In ponds smaller than one-half acre, they do not maintain the desirable balance between the bass and bluegills.

The common species combination in use on an unfertilized (per acre) basis are:

1. Bass (50) and bluegills (500), 10 to 30 percent of the bluegills may be redear sunfish.
2. Bass (50), bluegills (500), and channel catfish (100). With this combination one can expect a 50 percent reduction in bluegill growth.
3. Bass (50), channel catfish (3000), channel catfish and fatheaded minnows (1000). In this combination the catfish are fed a commercial pelleted food. The bass are used as policemen to keep unwanted fish out of the pond. The fatheaded minnows feed the bass. This stocking rate calls for restocking every third year, or as soon as fishing deteriorates. Draw down the pond and remove any fish left, then restock.
4. Catfish alone (150-250). Spawning containers added will allow reproduction.

When putting fish into a pond, the water in the container holding the fingerlings should be tempered with pond water until it is about the same temperature as the pond. This can be done by placing the container in the pond and splashing water into it, until the water in the container approximates the temperature of the pond. If the fingerlings are abruptly thrown into the pond and the temperature difference between the two is 10°F or more, they may die of thermal shock.

Fishing can start in a bass and bluegill pond after juvenile bass have been found in June or July of the second summer. If juvenile bass are absent, postpone fishing until bass reproduction is present. Small bass are shaped much like the adults and have a black line running down their sides from the eye to the tail. Young bluegills have a shape similar to the adults and have six or eight dark bars extending from the back down the sides at right angles to the long axis of the fish.

Fishing the first year, especially in ponds two acres or less, should be light on the bass, or they can be thrown out of balance later on. Once fishing is started, try to remove four to six pounds of bluegills for every pound of bass taken out.

IV. Management

A. Fertilization

Fertilization of a pond can increase the carrying capacity of that pond twofold. However, if a complete fertilization program isn't carried out, it can be worse than none at all. Some of the salient points to remember when fertilizing are (1) use a 4-4-1 ratio, if possible. If this isn't available, a 1-1-1 ratio can be used, (2) the amount to use will depend on the natural fertility of the pond and its watershed. Start with a bag per acre and continue applying at weekly

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intervals until a bloom is achieved. When a white object the size of a coffee can lid can be seen at 18 inches, it is time to add more fertilizer, (3) if the pond is below the pH of 6.5, an application of lime can be made to improve the utilization of the fertilizer. Use ground agricultural limestone at the rate of up to one ton per acre. This will last from two to four years, depending on the acidity of the water and the amount of water passing through the pond. Hydrated forms of lime can be used but applications should not exceed 50 lbs. per acre. Applications of hydrated lime will last one year, (4) fertilize from about the end of February or March to September. Using water temperature as a guide, start fertilizing when the water reaches 60°F, (5) how to fertilize--fertilizer can be thrown in the pond from the edge or from a boat, but keep it in 4 feet of water or less. If it is thrown in deeper water, it may be unavailable to surface water. Also, it can be chemically tied up in the bottom muds of the pond, (6) after a pond has been properly fertilized for three to five years, all that is necessary is phosphate. Use 40 pounds per acre of superphosphate or 18 pounds of the triplephosphate per acre. A fertilizer platform built about one foot below the surface can also be used. Just dump the fertilizer on the platform and let the surface currents carry the fertilizer throughout the pond.

B. Food Chain

The addition of fertilizer greatly expands the carrying capacity of a farm pond. This is caused by an increase in the number of microscopic plants (phytoplankton) which utilize the fertilizer. This increase in phytoplankton provides more food for the small animals that prey on these small plants. This vast assemblage, called plankton, feed the aquatic insect population which, because of more food, become more numerous. The aquatic insects are food for small fish, both bass and bluegills. These small fish are the food of the larger bass. Since there is more food for the smaller fish, they can grow larger and reproduce more rapidly. Since the basic food is more abundant, more fish can live in a given acreage of water.

C. Fishing

When fishing is started it would greatly help retain the balance if four to six pounds of bluegills were removed for every pound of bass taken out. If this cannot be done by hook and line, a seine might be employed to remove the excess bulegills.

In a balanced bass and bluegill population there should be a graduation of size classes from the very smallest, newly hatched bluegill up to large ones. The same size class distribution should be present in the bass. There should not be just a few size classes which comprise the bulk of the population. If such a condition exists, the pond is in trouble and going out of balance.

If for any reason the balance between bass and bluegills is destroyed, say by a fish kill, fishing will deteriorate. It can go either in favor of the bluegills, which is the usual case, or in favor of the bass, a rare occurrence. What occurs during this condition is this--

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(and here we'll consider the bass as suffering a kill), the bass are not able to control the number of bluegills. These prolific fish keep multiplying and the individual bluegill will get less food. This causes them to be thin and popeyed. Soon there is a stunted, starving population of bluegills with only two or three size classes.

When the bass are nesting they may be surrounded by ravenously hungary bluegills who are trying to get the bass eggs. Maybe one will dart in and grab an egg. The bass will kill or run him off, but when he does this, two or three others will jump in and grab eggs. This is bad, but not as bad as when the little bass hatch and are left by the male bass. They are then at the mercy of the bluegills, who gobble them up. This will mean no, or very little, bass reproduction. During all this time natural mortality and fishing is reducing the adult bass population. The pond ends up with a million little bluegills, not worth the effort to catch, and a few big bass.

The reverse sometimes happens but not very often. In this type of unbalance the bass are stunted and numerous, whereas the bluegills are large and scarce.

D. Methods of Balance Renovation

1. Seining - If a pond is two acres or under it can be brought back by the use of a seine. Seine the pond once a week and remove all bluegills. Return all bass. Keep this up until the bluegills caught are noticably larger, then discontinue.

2. Partial rotenoning - During late September or October, around noon on a still, bright day, add one pint of the emulsifiable rotenone, or one pound of the 5 percent dust, per 300 feet of shoreline, 15 to 30 feet from shore. This should only be undertaken in ponds three acres or larger. The results of this treatment should be checked by a biologist. Two treatments may be necessary.

3. Drawdown - During July the surface area of the pond should be reduced by 50 percent and remain this way until October. This does the following:

   a. It physically eliminates spawning areas for the bluegills.

   b. It concentrates the bluegills where the bass can "work" them over. This is during the time of the year when the bass can eat ravenously and use this food for growth.

   c. The crowding of fish into a small area causes a chemical reproductive repressant to be generated and greatly reduces bluegill reproduction.

   During October, allow the pond to refill. Next spring check the results of the drawdown with seine samples.

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E. Fish Kills

Fish die for many reasons. Below are listed four of the most common causes:

1. Oxygen depletion and turnover - when a series of still, hot, cloudy days occur during spring, summer, or fall, a fish kill for the lack of oxygen in the water can occur. This is caused by:

   a. Hot water will physically hold less oxygen than cold water.

   b. Cloudy weather cuts off sunshine, which is the energy source for phytoplankton food manufacturing. No food manufactured; no oxygen given off as a by-product.

   c. Still or calm weather eliminates wave action and no mixing of air and water. A turnover can be caused by either a heavy cold rain or a strong wind, as previously explained.

   The killing of fish is caused by putting them into a mass of water charged with toxic gases, Hydrogen sulfide (H_2S), Methane (CH_4), Ammonia (NH_4), Carbon dioxide (CO_2), and Carbon monoxide (CO), and minus Oxygen (O_2). The longer the pond has been stratified, the more serious the kill.

2. Insecticides are extremely toxic and can kill fish when measured in parts per billion. Stopping a fish kill by these chemicals is impossible by means available to the average person. Adding fresh water would be the best solution. Flush the pond out and then see what is left of the fish population.

3. Toxic algae - Two forms of blue-green algae, Anacystis (microcystis) and Anabaena, can cause fish kills. This is done in three ways.

   a. Masses of these microscopic algae float to the surface and form a scum. This scum cuts off the sunlight and stops the photosynthesis activity of the phytoplankton. This stops their oxygen production.

   b. The algae become so thick in the water that their body wastes reaches toxic levels in the water. This is true of certain species of Anacystis especially.

   c. Population of Anabaena build up rapidly and decline just as quickly. After they have reached their peak of abundance the whole population dies and the dead cells rupture and release a chemical into the water that is toxic to the fish.

   Correction of an algae bloom is done by flushing out the pond with fresh water or treating it with copper sulfate to kill the bloom. If copper sulfate is used, one or two days later an oxygen depletion may take place (depending on the weather) so the owner should have a pump handy to recirculate the water.

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4. Diseases and parasites. These do kill fish on occasion and treatment will depend on the particular disease or parasite present. This is a job for a fishery biologist and treatments will not be included here. If a fish is suspected of harboring a parasite or disease try to have one or two live specimens present for a fishery biologist to examine. If a live specimen isn't available, find a recently dead fish and freeze it for a postmortem.

F. Combating Kills

One of the safest things to tell a landowner whose fish are dying is, add fresh water or recirculate the water in the pond. This has three advantages:

1. It adds oxygen to the water. The lack of this gas may be the reason why the fish are dying.

2. The oxygen added to the water by splashing may chemically reduce the toxic effect of substance present.

3. By adding fresh water the toxic agent, parasite or algae bloom, may be flushed out of the pond.

There are other chemicals that can be added to pond water to combat a fish kill, but at this time these cannot be given here until these chemicals are cleared by the F.D.A. A list of chemicals cleared by this Federal organization will be periodically issued when new chemicals are approved for use in waters containing food fish.

G. Correction of a Fish Kill

After a fish kill, check the pond by a seine sample. The amount of remaining fish will determine the final action taken. If very few fish remain, or if the balance is decidedly in favor of one specie, one could draw down the pond and retonone; then restock. A slightly out-of-balance condition may be corrected in the manner described under correction of an unbalanced population.

Frequently people will want to add additional fish to correct an unbalanced population caused by a kill. This is almost an impossible solution to this problem unless a very accurate count of the remaining fish is made. It is not advisable to add fish to correct the effects of a fish kill.

V. Weed Control

A. Weeds Are Undesirable Because:

1. They offer a place for small bluegills to escape bass predation.

2. They physically inhibit fishing, swimming, boating, and removal of irrigation water.

3. They can cause an oxygen depletion if they die suddenly.

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B. How weeds enter a pond - Weeds can get into a pond via flooding; or animals such as muskrat, nutria, or wading birds may carry the seeds on their fur, feathers, or feet. Man can bring them in via bait pails or boats.

C. Types of weeds - There are four general types of weeds; free floating (duckweed, water hyacinth, etc.), floating leafed (lilies, watershield pondweed, etc.), submersed (coontail, najas, muskgrass, etc.), and emergent (cattails, rushes, buttonwillow, etc.).

D. Control

1. Mechanical - This involves physical or mechanical removal of the weeds in question, such as hand pulling or mowing of cattails and rushes, or underwater mowing of submersed weeds. Deepening the pond's edges also falls into this category.

2. Biological - Fertilization and the subsequent "bloom" shades out weeds that grow below the surface. Grazing of cattle is a biological means. Feeding of ducks or geese - these birds eat many aquatic weeds such as duckweeds, (Pekin or Muscovy duck), najas, chara or pondweeds (geese and ducks).

3. Chemical - again F.D.A. ruling prevents listing of chemicals that can control weeds, with the exception of copper sulfate used on algae. If the owner wants to control weeds chemically, have the weed identified and tell him what he has. He in turn can consult with a store handling herbicides and have someone there tell him what chemical will control which weed.

   Most aquatic herbicides, if properly used, are not toxic to fish. However, some are toxic to animals that may drink the water. Check the label on the container for directions and cautions to be used with that chemical.

   Two chemicals that should be avoided in a pond are Treflan and Acrolein. These are toxic to fish.

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LAND MANAGEMENT FOR WHITETAIL DEER

The whitetail deer is a very popular game animal and common over many areas in the State. They are very prolific and can obtain high populations if correctly managed. Four important factors that are detrimental to deer populations are: (1) poaching, (2) free-running dogs, (3) competition for food by free-ranging cattle, and (4) allowing the deer herd to exceed the carrying capacity of the range.

The massive clearing of woodlands in the delta is removing the best deer range in the State. This will shift a big portion of the hunting pressure to other areas in Louisiana. A landowner having suitable woodlands and deer on these areas has the opportunity of increasing his income by the sale of hunting rights.

The range of the whitetail deer varies according to the adequacy of its habitat. The more favorable, the smaller the range and vice versa. Generally, the home range will be about one square mile, although some individuals may stray over 10 to 15 miles in the course of the year.

The breeding season of the whitetail in Louisiana varies according to the location and extends from September to February. The gestation period is between 195-200 days. The fawning season extends from April until early August, depending on the locality. At her first breeding, a doe will usually produce a single fawn. Thereafter, on good range, twins are usually delivered. One buck can serve as many willing does as he can find.

The average deer will weigh about 100 pounds with extreme weights in excess of 300 pounds. The weight, antler development, and the annual fawn crop are indicators of the range conditions. If any or all of these are found low, a sound habitat improvement program will go a long way toward remedying these shortcomings.

Deer frequently become pests in agricultural areas where a choice food, such as soybeans, is grown. These animals sometimes can be controlled by firecracker strings, chemical repellents, flashguns or other devices. When deer do become a problem, consult with the local representative of the Louisiana Wild Life and Fisheries Commission.

Place in Conservation Planning

Deer are primarily woodland animals but also utilize open fields. Uneven age woodland with small openings (1 to 5 acres) scattered over the area, and with a dependable, well distributed water supply, are the preferred habitat.

Food

A wide range of food is taken - twigs, leaves, fruit, fungi, herbaceous plants, grasses and vines. Some of the choice native species of food are rattan, trumpetcreeper, jessamine, greenbrier, honeysuckle, fringetree, French mulberry (beautyberry), gallberry, possumhaw, yaupon, rusty blackhaw, red bay, white bay, sumac, black and dewberries, blueberries, sweetleaf, hawthorn, persimmon, beech, oaks, maples, blackgum, sassafras, and mushrooms. Favored agricultural

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crops are clover, corn, soybeans, wheat, rye, ryegrass, cowpeas and others.

Deer feed from ground level to about 4 feet above the ground. If pressed, they will feed higher, but when they do, it is a sign that their range is deteriorating.

Cover

Deer, being woodland animals, usually are in the forest most of the time. However, they do use fields for feeding, especially at dusk, dark, and dawn. Young pine plantations are used extensively as bedding areas, if other heavy cover is absent. A woodland with an uneven age group of stands should furnish all the cover needed.

Water

The whitetail needs a year-round water supply. It should be well distributed over the area in which the herd lives. Live streams, dug or impounded ponds or springs can be developed to furnish this water.

Management

Woodland management - Since deer are mainly browsers and grazers, any practice which will stimulate the production of browse, forbs, or grasses will be beneficial. The creation of an uneven age stand of woodland is most desirable. Selection or block cutting will give this effect. The selection cut (taking out economically mature trees) will give small openings scattered over the area. Block cutting, in units of 10 to 40 acres, will also produce the same effect on a larger scale. The removal of the overstory will allow sunlight to reach the forest floor and stimulate the growth of forbs, grasses, and brush. The tree stumps furnish sprouts which are readily taken.

Since acorns are a highly nutritious food and a favored one too, oaks should be favored in any woodland management plan.

When converting an area from hardwoods to pine, the stream and creek bottoms, and low flats should remain in hardwoods. If the landowner is interested in deer and wishes to maintain their number, retain from 5 to 10 square feet of basal area per acre, preferably of oaks. If it is possible, have both the red and white oaks represented in the trees retained.

In pure pine management, understory trees such as dogwood, yaupon, beautyberry, sweetleaf, and rusty blackhaw should be spared and encouraged. These low growing trees and shrubs will not interfere with the pine and still produce food for deer. If the area is void of oaks and the owner wants some, the sawtooth oak is a good one to plant. This exotic oak produces fruit at an early age, is fairly regular in acorn production and produces a large, meaty acorn.

Woodland openings

From one to five percent of the wooded area should be open. These can be in small fields cleared in the woods, utility rights-of-way or any other form of opening. The cleared fields can range in size from one-half to five acres.

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Long rectangular openings are used more than square or round ones. Such openings should be planted to choice foods such as clovers (crimson, ladino, button, burr, and red), vetch, alfalfa, fescue, rescuegrass, oats, ryegrass, rye, winter wheat, shrub lespedeza or soybeans. These plantings should receive the same treatment that an agricultural crop would get. They should be well limed and fertilized to produce crops with necessary mineral elements for the development of healthy, well-antlered, and fecund animals. When turkeys are present in the same area, double the size of the openings. If plantings are not made, bulldoze the trees up in piles and plant honeysuckle in the brush piles. This will protect this plant from the deer while it is becoming established. Honeysuckle is a choice deer food.

When the soils under management for deer lack the necessary mineral elements, salt blocks with trace elements added may be put out. If these are not used, find an area where the deer frequent and bury a bag of mineral salt, leaving some of the salt exposed. This works best in silt and clay soils because the salt doesn't leach out as quickly.

Other areas that can be used for planting in woodlands are logging roads, sawmill sites, log decks and narrow utility rights-of-way. Shade tolerant plants work best in such an area unless they are especially large.

Cattle and deer can coexist on the same range providing the cattle grazing is regulated. Hogs can also live with deer but should not be too numerous, because they are strong competitors for mast crops. For the best management of deer, hogs and cattle should be removed.

Harvest

To adequately maintain a healthy deer herd, the population should be thinned periodically by doe or either sex hunts. If a bucks-only law stays in force too long, the range will suffer from overbrowsing by too many deer. The changing of the laws to allow harvest of does is up to the legislator or the Fish and Game Commission, but they must be notified about overpopulation before overbrowsing takes place.

An annual removal of 30 percent of a deer herd will not effect its ability to repopulate the area. Sometimes even higher numbers must be removed before the range can regain its former vigor.

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The native wild turkey is a creature of the forest and thrives best in the larger tracts of well-watered woodland. The species composition of the woodland should be mixed and the area should be composed of different age groups. However, turkeys will do well in mature pine stands if the bottomland hardwoods are retained. A minimum of 1000 acres is considered as the basic unit for management. A landowner may own less than 1000 acres and still have turkeys present, but they will not remain on his land all the time. Turkeys have a wide foraging range, but this can be considerably reduced if choice food is present.

While larger blocks of timber are needed to retain turkeys, they should not be solid stands, because small openings scattered over the area are a necessity. About one to two percent of the area should be open. Openings such as old fields, rights-of-way, old sawmill sites, etc., producing many of the turkeys' choice foods, are highly desirable in any plan of management. In dense areas sufficient travel lanes should be maintained.

The wild turkey is the largest American game bird, with adult gobblers or toms reaching a length of 48 inches and a reported weight of 30 lbs. although the average weight is between 16-19 lbs. The hens are smaller and duller colored than the toms and weigh between 7-12 lbs. The sexes can be distinguished thusly: males - a "beard" present on the breast 3 to 11 inches long and the breast feathers are tipped in black; females - no beard present, or if one is, it is usually 3 inches or less, and breast feathers are buff-type. Beards have been found on hens up to 7 1/4 inches, but these occur rarely. These characteristics are not reliable on young birds.

Turkeys are polygamous, with a mature gobbler having a harem of two to seven hens. Young gobblers, while believed to be capable of breeding, seldom do until their second year - probably due to the dominance of adult males.

Turkeys are ground nesters, usually selecting a nest site near some form of opening, such as an abandoned field, and near a water source. The hen, during the nesting season of March to June, lays from 7 to 15 eggs, which hatch in 28 days. Clutches average around 11 to 12 eggs. Nesting success is usually about 50 percent. Nesting after the middle of May is usually second or third attempts to reproduce. Most serious predators are man, dogs, racoon, skunks and the crow.

Place in Conservation Planning

Turkeys should be considered on areas adjacent to or in large blacks of mixed woodland where these birds are present, or can be restocked. Controlled burning, wildlife habitat management, pasture planting, and proper forest management are all important practices to consider in planning for turkey.

Food

The foods of turkeys include acorns, beechnuts, blackgum, black cherry, blueberries, dogwood, grass seeds (especially paspalum and panicum), greenbrier, holly, huckleberries, magnolia, partridge berry, pine mast, pecans, poison ivy,

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sweetgum, tender greens, wild grapes and insects (especially crickets and grasshoppers during summer and early fall).

Cultivated crops taken are: browntop, proso, and Texas millets, chufas, clovers, oats, rye, wheat and any tender grasses or greens. The major food problem occurs during winter and late winter--during time of mast shortage wheat is a very good supplementary food.

Water

Water must be present year-round on turkey range. Water holes can be dug, small streams impounded, or springs developed to furnish this water.

Management

In hardwoods, select tree cutting is recommended. Even-age stands are not desirable. Opening created by logging operations will be filled with many plants that furnish food for turkeys. Oaks, beech, blackgum, cherry, dogwood, holly and pecan should be favored in woodland management.

When harvesting, try to leave several stands of tall trees scattered over the area, especially in swamps, which can be used for roosts. Timber harvests, during March, April and May should be confined to unoccupied portions of the turkey range so as not to disrupt nesting. Turkeys are somewhat sensative to disturbances while nesting and will frequently abandon a nest during early egg laying, but after the eggs are laid, this is less likely to happen.

In the pure pine stands of the uplands, controlled burning is very useful, since many desirable grasses and annuals follow a burn. Controlled burning should be done prior to the onset of the breeding season which begins in late March. Disking and fertilizing strips in pine woodland is also a useful practice for supplementary food. Planting of sawtooth oaks and Chinese chestnuts also produce food for turkeys.

Openings should be present in the woodland for best results. One to five percent of the area should be in small, well-distributed fields. A ratio of one or two acres per hundred is ideal. These fields can be planted to any of the foods listed above. If deer are present, double the size of openings made. Full use should be made of all existing openings such as utilities rights-of-way, old fields, abandoned oil well sites, and sawmills. In larger openings leave part of the area as idle land or rotate supplementary food plantings.

Hunting should be strictly controlled and no more than one-third of the population removed during any season. Poaching should be eliminated and wild dogs controlled.

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INTRODUCTION

The following is a key for plants that may be found in farm ponds. It can be used with a high degree of success for aquatic plants in the wild, but it is not all inclusive, so some species may show up that are not included.

A key is a series of choices. Plants with similar characteristics are grouped and these groups presented as alternates in the key. For example, you find a woody plant growing along the edge of a farm pond and turn to the key for aid. The first choice you have is shrubs or trees, or herbs. Since the stem is woody, this eliminates herbs, so you go to Group A. Under Group A you have two choices, leaves opposite or leaves alternate. Since the leaves are alternate, you move on to number 2. Here again two choices are available. The plant you found has narrow and elliptical leaves, so it is a willow.

Under some conditions there may be a series of choices, 3 to 5 alternates, because so many plants fall under one large group.

Be careful, read all the choices, gather as much of the plant as possible, and be sure that you have all the different kinds of the plants in a pond with weed problems. If the key doesn't work out to your satisfaction, send a specimen to the state office for identification.

KEY TO AQUATIC PLANTS

I Shrubs or Trees - Group A

I Herbs - II

II Plants, free floating - Group B

II Plants attached to bottom - III (Free floating masses of the plant in question may be present that have broaken loose from the bottom. Check to see if attached vegetation is present.)

III Stems limp and floating, submerged or on the surface - Group C

III Stems erect and emergent, rooted - Group D

Group A

1. Leaves opposite or whorled in 3's - fruiting head round - Buttonbush

1. Leaves alternate - 2

2. Leaves narrow and elliptical, bark rough - Willows

2. Leaves egg-shaped, bark relatively smooth and gray, trunk fluted- Alders.

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Group B

1. Very small green or red plants about 1/16 to 3/8 inch long. Rootlets may be present dangling in the water.

   a. Plants green, (sometimes reddish) small 1/16 to 1/8 inch, oval, nearly circular or in some cases cresent-shaped. May look like small green seeds floating on the water - Duckweeds.

   b. Plants red to brownish-red plants larger than above 1/4 to 1/2 inch long. Composed of a forked stalk with overlapping scales - Waterfern.

1. Plants very much larger and taller.

   a. Plants with large, deep green glossy leaves which are circular to heart-shaped with inflated bases. One to many such leaves, large mass of roots floating in water. May attach themselves to mud in shallow water. Up to 2 feet tall and bearing beautiful purple flowers - Water Hyacinth.

   b. Plants not as above. Resembling an open head of lettuce. Leaves wrinkled, velvety and light green in color. Roots trailing in the water - Water lettuce.

   c. Leaves roughly heart-shaped, long stalked from a central cluster. Leaf veins originating from the point of attachment to stem. Flower white. Fruit rounded and dropping at maturity - Frogbit.

Group C

1. Plants with surface leaves - 2

   2. Leaves circular, oval, elliptical or heart-shaped - 4

      4. Leaves Circular

         a. Leaves small, less than 2 inches, with indented edges, one leaf per stalk. Stem attached at middle of leaf. Stem arises from a creeping rootstock - Pennywort

         b. Leaves larger, 4 to 10 inches in diameter, a single deep cleft. Flower large and showy, white to pink - Waterlily.

         c. Leaves very large, erect or floating on the surface, up to 24 inches in diameter. Margins of leaves turned up on some. Flower large, yellow, erect on a separate stalk. Seed pod hemispherical with flat top and large seeds - Lotus.

      4. Leaves Oval

         a. Leaves 3/4 to 4 inches long, connected to the stem in the

middle of underside. Underside and stem red, encased with a slimy covering. No underwater leaves. Flowers inconspicuously brick red.- Watershield.

b. Leaves connected as above, but smaller - 3/4 inch or less, not red or slimy. Leaves small. Underwater leaves fan-shaped and divided - Fanwort.

c. Surface leaves of various sizes, generally small, 1/2 inch to 4 inches, and connected to stem at end of leaf. Underwater leaves narrow and grass-like, length variable. Seed head may be stalked and above the water or in clusters in axils of the leaves - Pondweeds.

4. Leaves Heart-shaped

a. Leaves small, deeply cleft, 1 to 6 inches in diameter with irregular edges. Flowers white, several and stalked, with the stalk originating from the stem just below the leaf - Floating Heart.

b. Leaves large 7 to 16 inches. May be held upright or laying on the water. Flowers solitary, yellow, waxy and born on a separate upright stalk above the water - Spatterdock, Cow lily, Yellow Waterlily.

4. Leaves Not as Above

a. Leaves elliptical and alternate. Above the leaf base is a sheath clasping the stem, the upper edge of which is fringed with long hairs. Nodes swollen. Flowers small, pink or white - Smartweed.

b. Leaves many, elliptical and opposite. Leaves and stems succulent forming floating mats on the water or standing upright in shallow water or damp soil. Flowers small, white cloverlike and on stalk standing above the water. Alligatorweed or Alligatorgrass.

c. Leaves elliptical. Upright stems are red and the sprawling, vinelike ones on the water are green. Occasionally stems turn up and have aerial leaves that have enlarged rounded tips. Flowers, yellow, are borne on aerial shoots - Waterprimrose.

d. Leaves opposite, with enlarged, rounded or pointed tips. Stems red all year but the whole plant turns red during the winter - False Loosestrife.

e. Leaves solitary, short and grasslike, and continuing as a sheath below the base of the blade. Stems limp and fine. This plant forms mats on the surface in shallow water, but sometimes extending into deeper water - Carolina Watergrass.

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1. Plants Without Surface Leaves - 3

3. Plants having stems and undivided leaves or just undivided leaves--1.

1. Plants with simple undivided leaves - 2

2. Leaves whorled on stems

a. Stems and leaves medium to dark green, brittle, have a gritty feeling when handled. Leaves round and curved upward. Have a pungent odor when crushed. Small black "seeds" may be present - Chara.*

b. Leaves whorled, flat, short grass-like, light to dark green and translucent. Flower small, pale yellow, 3 petals - Waterweed.

c. Leaves generally whorled but may appear alternate. Blades grasslike, flat and pointed. Plants coming from a continuous black runner - Juncus repens.

2. Leaves Opposite

a. Leaves narrow and grass-like, short and pointed. Plants from green to brown. Generally grows in dense beds. Seed spindle-shaped, borne in axils of the leaves - Najas.

b. Leaves pale to bright green with enlarged, rounded tips. Generally it does not grow in dense beds - Waterstarwort.

2. Leaves Alternate

a. Leaves flat and grass-like, may be whorled or alternate. Plants arising from a continuous black runner - Juncus repens.

b. Stems round, leaves flat, narrow and of varying length, grasslike. Seed flattened laterally, but rounded in sideview, found in clusters below or stalked above the water - Pondweed.

c. Stems and leaves wirey and round, branching into a tangled mass, dark green. May be attached or free floating in mats - Proliferating Spikerush.

1. Leaves Divided Once or More

a. Leaves whorled and forked once or more at the tip and have a spiny appearance - Coontail*

* Use extreme care with this plant as it sometimes closely resembles Coontail. Check the accompaning drawing at the close of this key.

b. Leaves fan-shaped and finely divided, may be whorled or opposite - Fanwort.

c. Leaves finely divided, may be whorled or alternate, grayish-green to bright green in color. Translucent green or black "seed-like" units sometimes present. Flowers are stalked and above water, three petals, yellow or purple. A highly variable plant - Bladderwort.

d. Leaves finely divided, brownish or green in color, stems red or green, hollow, brittle, with a fine central wheel-like pith. Aerial leaves may be present - Watermilfoil or Parrotfeather.

Group D

1. Leaves grass-like--round, flat or V-shaped, especially near the base-2.

2. Leaves flat in cross section.

a. Leaves sword-shaped, narrowly elliptical in cross section. Seed head long cylindrical and brown at maturity - Cattail.

b. Leaves long up to 6 feet, grasslike with sharp cutting edges, seed head lax and drooping. Plant grows in large clumps and may turn tan or white in the winter - Giant cutgrass.

c. Leaves grasslike but V-shaped in cross section, especially at the base. Leaves 3 ranked and continuing as a sheath on the stem. Stems 3-sided, sometimes rounded on edges, pith filled without nodes. Seed heads of various types but usually prickly in appearance - Sedges.

2. Leaves Round in Cross Section

a. Leaves dark green with pointed tips. Fruit borne in a dangling cluster from the side, below the tip - Rushes.

b. Leaves medium to light green, short, 1 to 18 inches (stems square in cross section in one taller species). Seed head borne on tip of stems - Spikerush.

1. Leaves not grass-like, various shaped - 3

3. Leaves of Various Shapes - 1

1. Leaves Elliptical

a. At the leaf base is a clasping sheath enclosing stem, with long hairs protruding from the upper edge. Flowers, pink, green or white, small. Joints swollen - Smartweed.

b. Leaves may be as above or with enlarged rounded tips, growing upright on land, sprawling or "viney" on the water.

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Flowers yellow and one inch or more in diameter - Waterprimrose.

c. Leaves opposite, plants succulent, growing upright on land and forming mats in deeper water, flowers small, white and clover-like - Alligatorweed or Alligatorgrass.

d. Leaves elliptical, alternate, with 2 sharp, long thin spines (about 1/2 to 1 inch) at the base. Growing in damp soil to shallow water. Flowers blue to purple emerging from the leaf bases. Stems weak. Note: Spines may be absent in young plants - Waterleaf.

e. Leaves narrow and elliptical, only one per stalk. Stalk triangular in cross section. Flower stalk straight or branched, bearing a few to many small white 3-petal flowers - Bulltongue.

1. Leaves shaped like an Arrowhead

a. Tips of the lower leaf lobes rounded, flowers blue or purple - Pickerelweed.

b. Tips of the Lower Leaf Pointed

1. Lateral vein horizontally separating the leaf about in middle. This may not be distinct. Flowers small, many, and white, Flowering stalk branched - Arrowhead.

2. Lateral vein paralleling lower leaf lobe edge. Very noticable on back of leaf. Outer stems sheathing, inner ones like celery. Flowers yellowish or green, encased in a sheath - Arrow arum.

1. Leaves Heart-shaped

a. Leaves stalked, roughly heart-shaped, arising from a central cluster. Veins of leaves originating from the point of attachment. Flowers white. Fruit rounded and drooping at maturity - Frogbit.

b. Leaves heart-shaped, large,7 to 16 inches, and a single leaf per stalk. Flowers 1 to 1 1/2 inches in diameter, yellow and waxy - Spatterdock.

c. Many small heart-shaped leaves present. White flowers in a terminal, cylindrical cluster, often nodding and forming a "question mark" - Lizards-tail.

1. Leaves Round

a. Leaves round with indented margins, small, 1 to 2 inches in diameter - Pennywort.

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b. Leaves very large, up to 24 inches in diameter standing upright above the water. Flowers stalked above the water, large and yellow - Lotus.

1. Leaves Opposite

a. The opposite leaves are enlarged and rounded or pointed at the tip, plant turns red in the winter -- False Loosestrife.

1. Leaves Whorled

a. Leaves finely divided, bright Parrot green in color. Underwater leaves usually present; they are more finely divided than aerial leaves, larger, and brown in color. Stem brittle and green to brown in color and has a central wheel-like pitch - Parrotfeather.

b. Leaves prickly looking, elliptical, short, growing upright or leaning toward the main stem. Underwater leaves and stem as above - Watermilfoil.

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Divided leaves - leave which are divided into narrow subsections, which in turn are subdivided into smaller subsections. This subdivision may take place three or four times, or only once or twice.

Leaves alternate - leaves that are alternately placed (one on the left, the next on the right, etc.) along the stem. They are never directly across from one another except when crowded towards the tip of the plant.

Leaves opposite - leaves borne directly across from one another along the stem.

Leaves whorled - leaves, three or more, that are placed in a circle around the stem, all at the same level.

Leaf lobes - the lower portion of a leaf which protrudes below the point of petiole attachment.

Nodes - swollen points along the stem of a plant where leaves are or have been attached.

Leaf sheath - a continuation of the leaf blade which is completely or almost completely wrapped around the stem above the point of attachment.

Three-ranked leaves - leaves which are grown on a triangular stem and appears on these stems in an alternate placement.

Wheel-like pith - wheel-like pith resembles a spoked wheel, with the hub at the center and spokes of pith radiating out from this to the outer edge.

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A LIST OF PLANTS ILLUSTRATED

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Buttonbush (Cephalanthus) - Upper Left

A bushy,woody perennial that grows to the height of 6-7 feet or higher, in wet areas. The oval leaves are opposite or sometimes whorled in 3's or 4's. The fruit is round and slightly resembles sycamore "balls". The fruit disintegrates upon maturity into individual "wedge shaped" seeds.

Willow (Salix) - Upper Right

A low growing tree found in various wet to damp situations. The leaves are lance-shaped and borne alternately on the twigs. The fruit is a very small seed with long silky hairs. Frequently windrows of this seed under the tree make the ground look as if it were covered with down.

Alder (Alnus) - Lower Left

A woody shrub that will grow 10-15 feet or higher. The alternate leaves are roughly egg-shaped with a fine saw-tooth margin. The bark is smooth and gray and the trunk is generally grooved with rounded ridges. The seeds are borne is a small "cone", resembling a miniature pine cone.

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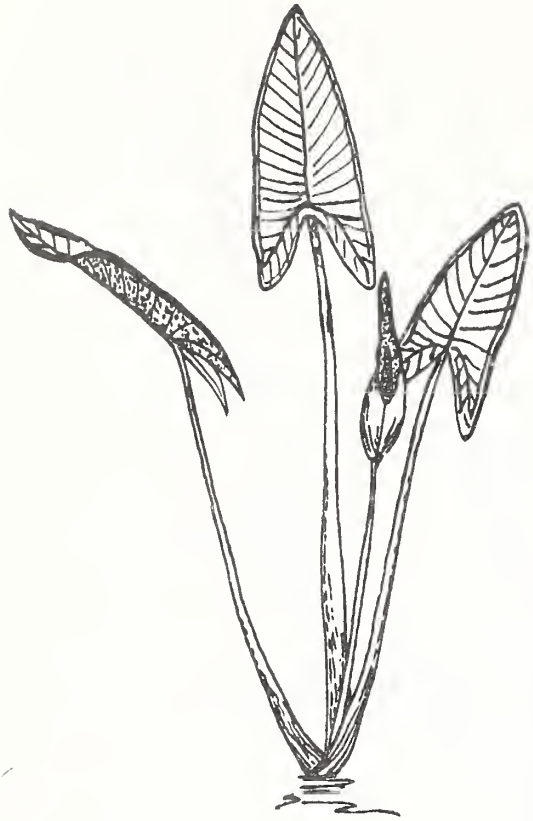

Arrow arum (Peltandra) - Upper Left

The leaves are shaped like a barbed arrowhead and are borne on thick "fleshy" stems. The yellow "flowers" are enclosed in a green, partly opened, sac-like structure which terminates in a wrinkled tip. The skin of the fruit is green, purplish or brown and the seeds are enclosed in a gelatinous mass within the fruit.

Arrowhead (Sagittaria) - Upper Right

The leaves are highly variable, but are generally arrowhead shaped, though the "barbs" may or may not be present, according to the species and water depth. The small white flowers are in whorls of three along the main stalk.

Pickerelweed (Pontederia) - Lower Left

The leaves are heart-shaped and are borne on thick stems. The flowers are bluish and found in a terminal spike.

Note: In the case where the flowers are absent, these plants may be differentiated by the veination of the leaves. See the illustrations.

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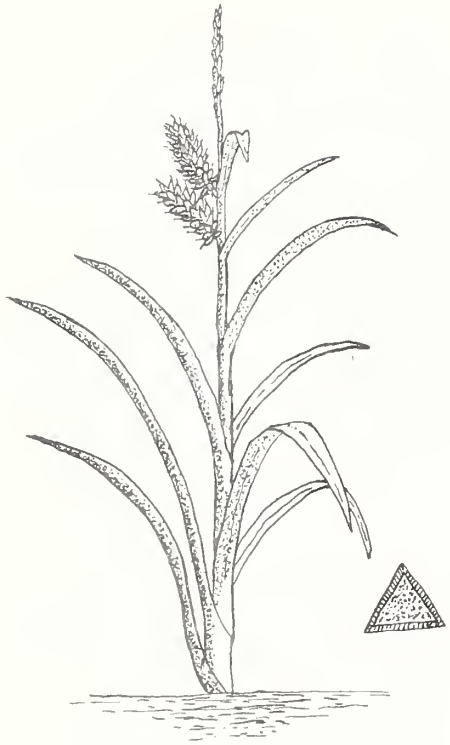
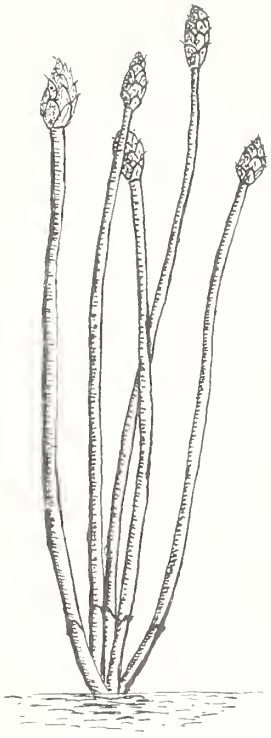
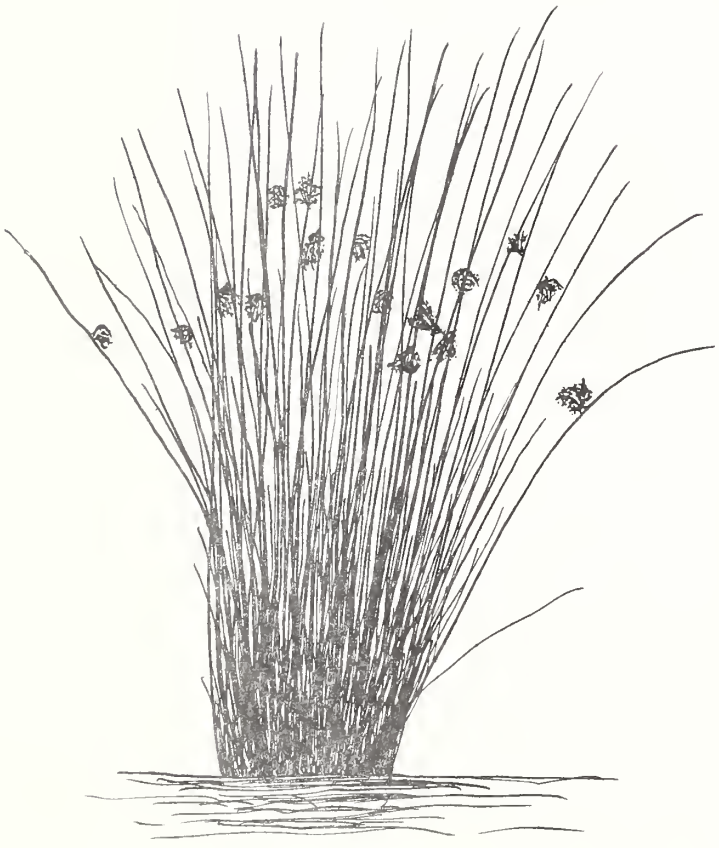




Spikerush (Eleocharis) - Upper Right

The round stems, without leaves, growing in or out of the water are generally low, 1 to 10 inches. The tallest of this group has a square stem in cross section and may be 24 inches tall. The "flowers" appear in the summer in small, oval, brownish seed heads at the tip of the stems. Ducks take the seeds of this plant and the tubers found on the roots of one species.



Sedges (Carex and others) - Upper Left

Grass-like plants with solid (pith-filled) stems that are triangular in cross section (see illustration). The sheaths of the leaves are closed and tightly attached to the stem. Flowering heads are "prickly" in appearance, cylindrically or spherically in shape. Leaves are "V" shaped in cross section.

Rushes (Juncus sp.) - Lower Left

The dark green stems (leaves) are cylindrical in cross section and pith filled. Seed heads are in drooping clusters attached to the stem 1 to 6 inches below the tip. These plants grow in dense clumps when mature and are found in or out of the water. Clumps may grow as tall as 4 feet, but usually are 2 to 3 feet in height.

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Smartweeds, Water Pepper (Polygonum)

Plants inhabiting the shallow water of a pond, with lance-shaped, alternate leaves. At the base of each leaf is a sheath going around the stem and topped with long, fine hairs. The flowers are pink, white, or greenish and found in terminal spikes or on short lateral spikes originating between the leaf and the stem. The seed is either triangular or lens-shaped in cross-section. These seeds are a choice food for ducks.

Lizardstail (Saururus)

Succulent herbs, with jointed stems and alternate drooping heart-shaped leaves, found along the edges of the water. The long, nodding, white flowered spike is present during the summer and easily distinguishes this plant.

Cattail (Typha)

Long, narrow, veinless, bluish-green leaves, sheathing at the base of the plant and the familiar seed head are enough to identify this plant.

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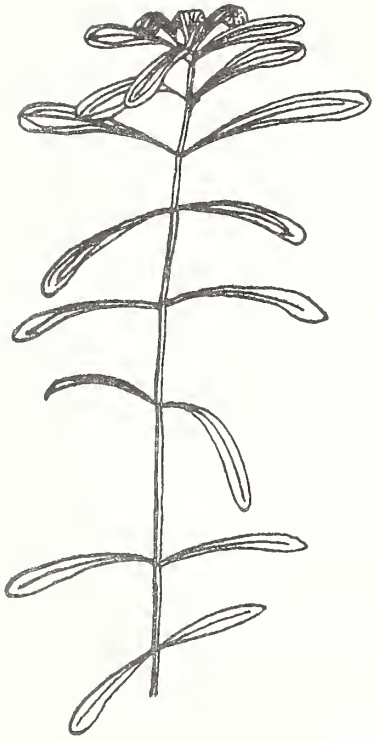

Water Starwort (Callitriche) - Upper Left
Small, aquatic perennials with slender stems growing in shallow water. The leaves are opposite, the lower submerged ones being narrowly cigar-shaped, while the upper floating leaves have widened tips. When looking down on the floating leaves, they roughly form a star-shaped pattern.

False Loosestrife (Ludvigia) - Upper Right
Low, marginal, succulent plants with opposite "spoon shaped" leaves. These plants usually are creeping or floating. The reddish stem and green leaves are distinctive. In the winter months the leaves may be red to purple.

Bur Reed (Sparganium) - Lower Left
A perennial aquatic plant growing in shallow water to damp sites. Prefers acid water. The leaves are grasslike, but more succulent and partly folded near the base. The seed heads, composed of elongated top-shaped seeds, are very distinctive in appearance and should serve to identify this plant.

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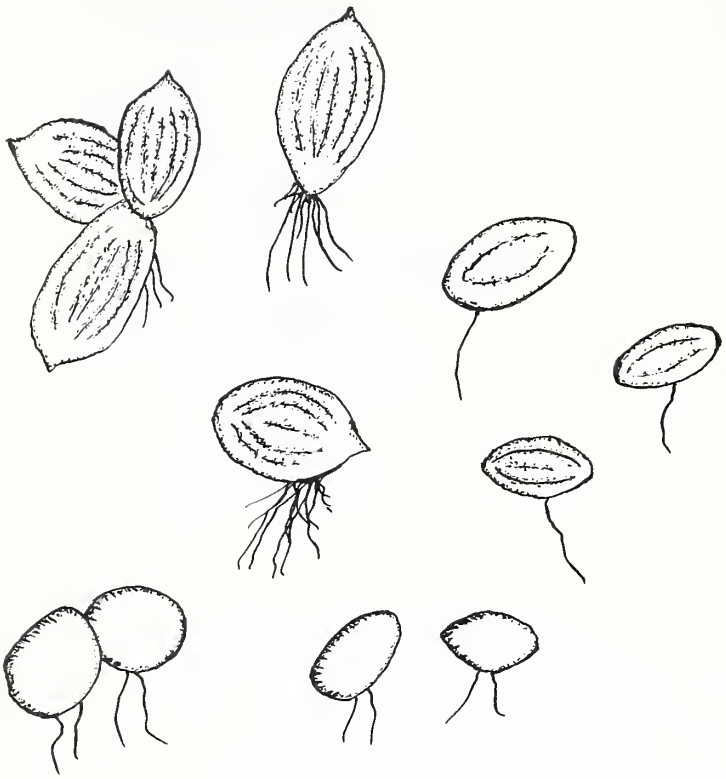
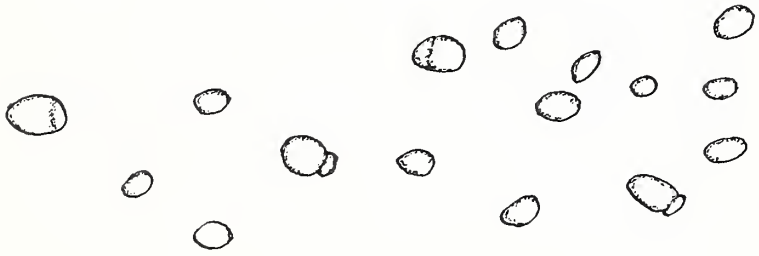
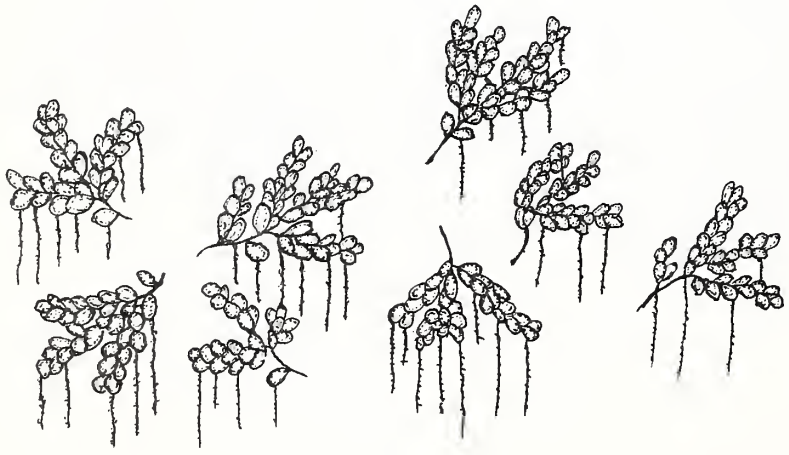
FREE FLOATING PLANTS



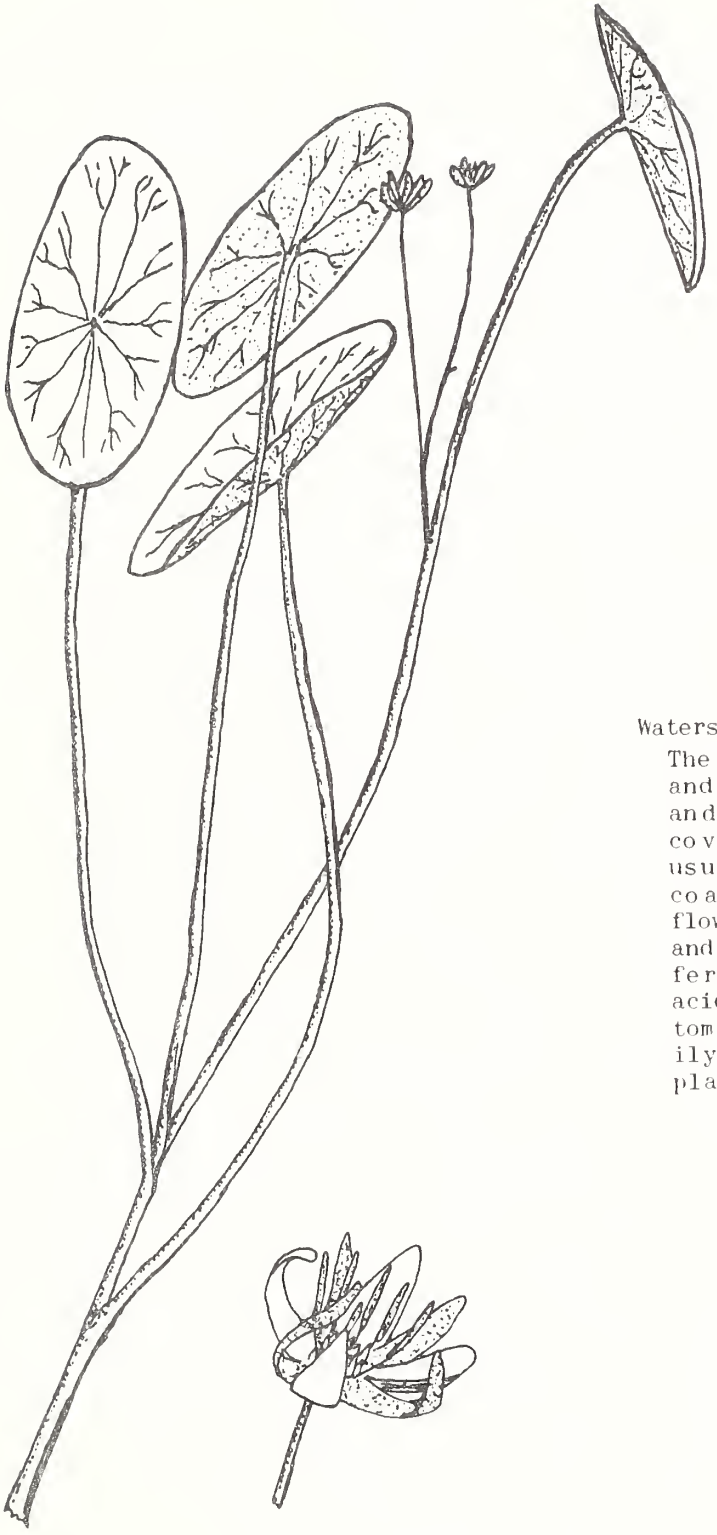
Duckweeds, Lemna and Spirodela spp.
Small, 1-12 mm long, free floating green plants of various shapes, generally oblong, that have one to many small rootlets hanging in the water, 1 to 15 nerves appearing on the top of the plants. Spirodela is larger and may be purple on the under side. These plants are 1-8 mm long, oval in outline with a small pointed tip, have many rootlets, and have 5-11 nerves on the upperside. Lemna has one to 5 nerves, one rootlet, green on the underside and smaller, being 1-5 mm. Under some conditions these plants may have a reddish color. It would be best to check them to prevent confusion with water fern.



Duckmeal, Wolffia and Wolfella spp.
The tiniest flowering plant in the world, .5-2 mm long, rootless, globullar to ellipsoid in outline.



Waterfern, Azolla sp.
Larger than the above, .5 to 1 cm long, having small overlapping leaves borne on a once to several times forking stem. Several small roots hanging in the water. At maturity these plants are red, rosey pink, or reddish brown. Young plants are green in color.



Watershield (Brasenia)

The floating leaves are oval and the undersides reddish and covered with a shiny covering. The stems are usually covered with this coating also. The small flowers are reddish to purple and have 3 to 4 petals. Prefers ponds or slow-moving acid water, with a sandy bottom. Some diving ducks readily take the seeds of this plant.

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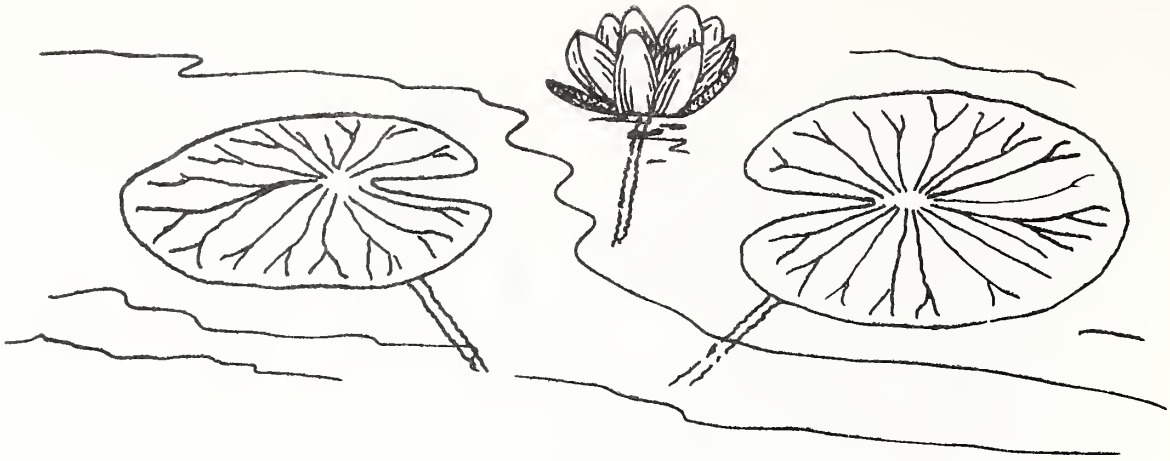

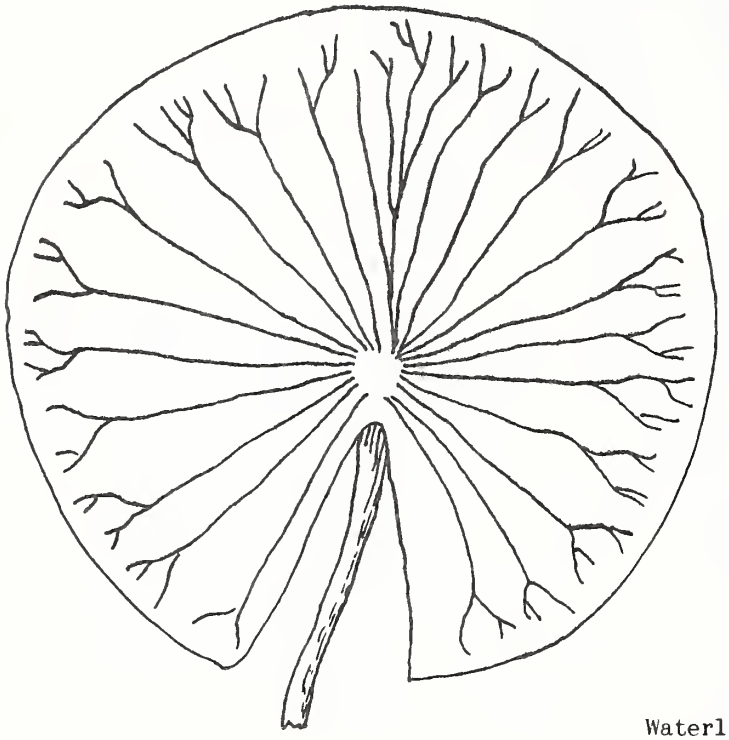

Waterlily (Nymphaea)

The large circular waxy floating leaves are deeply notched and borne on tough elastic stems. The large white, pink, yellow or blue flowers, with 12-40 petals, float on the surface with the leaves. The thick intertwining roots of this plant form extensive mats over the bottoms.

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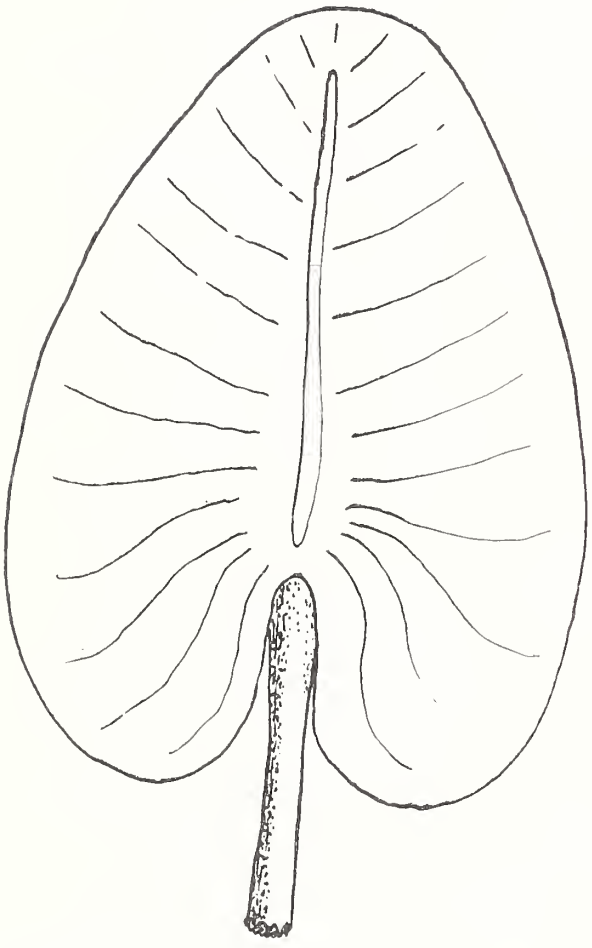
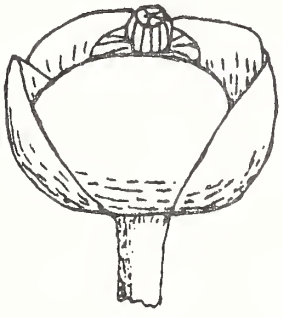


Spatterdock, Yellow Waterlily (Nuphar)
The large, waxy leaves are heart-shaped and may be upright or floating on the surface. The stems are thick, strong, and elastic. The small flowers are yellow and waxy in appearance. This plant is found in the shallows out to a depth of 3 or 4 feet.



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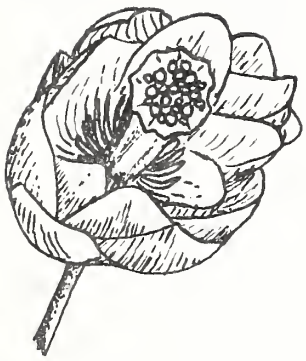
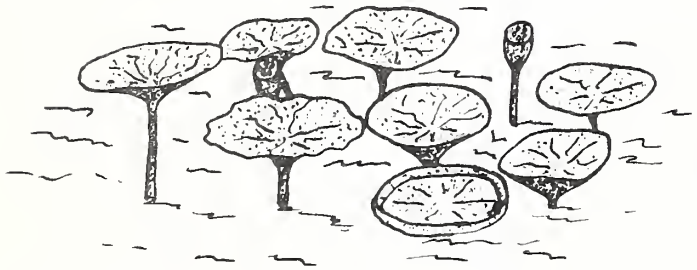
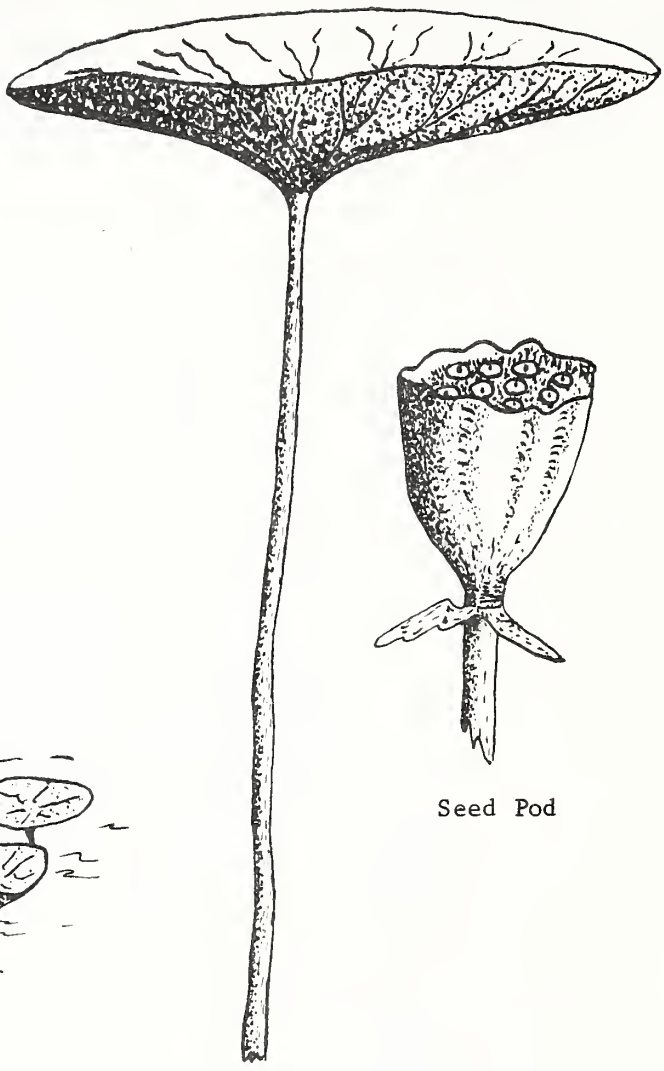


Flower





Leaf and Stem

Seed Pod

Lotus

leaves circular 12-24" in diameter, with the centers "cupped". Usually they stand up out of the water, but immature leaves lay on the surface.

stem 1/4 to 1/2" in diameter, stiff and upright.

flowers 4.5 to 10" in diameter, pale yellow in color.

special characteristics The large, cupped leaves which stand upright are distinctive and characteristic of no other native plant.

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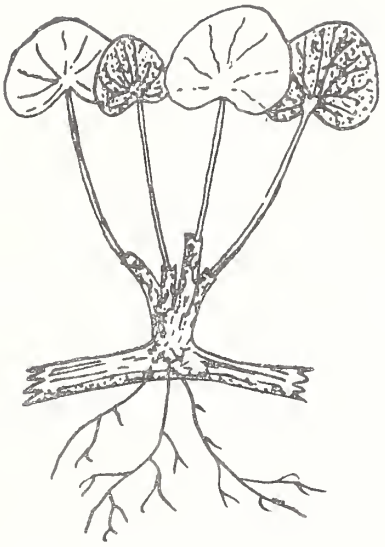

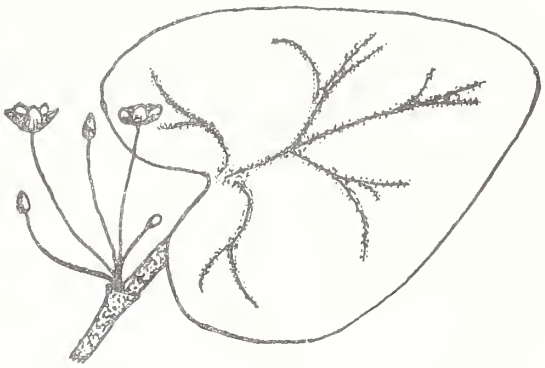

Mud Plantain (Heteranthera)-Upper Left

Leaves are in a flattened heart shape, stemming from creeping rootstocks. Usually growing in shallow water.

Floating Heart (Nymphoides)

Leaves small, 2-3 inches in diameter and roughly heart-shaped. Margins may be smooth or irregular in outline. The small white flowers are attached to the stem bearing the leaves just below the leaf. Occasionally a group of fleshy root-like structures are found on the leaf stem where the flower stalks arise.

Pennywort (Hydrocotyle) - Lower Left

Low, creeping plants with roughly circular leaves, the margins of which are wavy or indented. Leaves usually standing erect, but sometimes found floating. Flowers are borne in a small, round cluster. The fruit are roundish and ribbed vertically.

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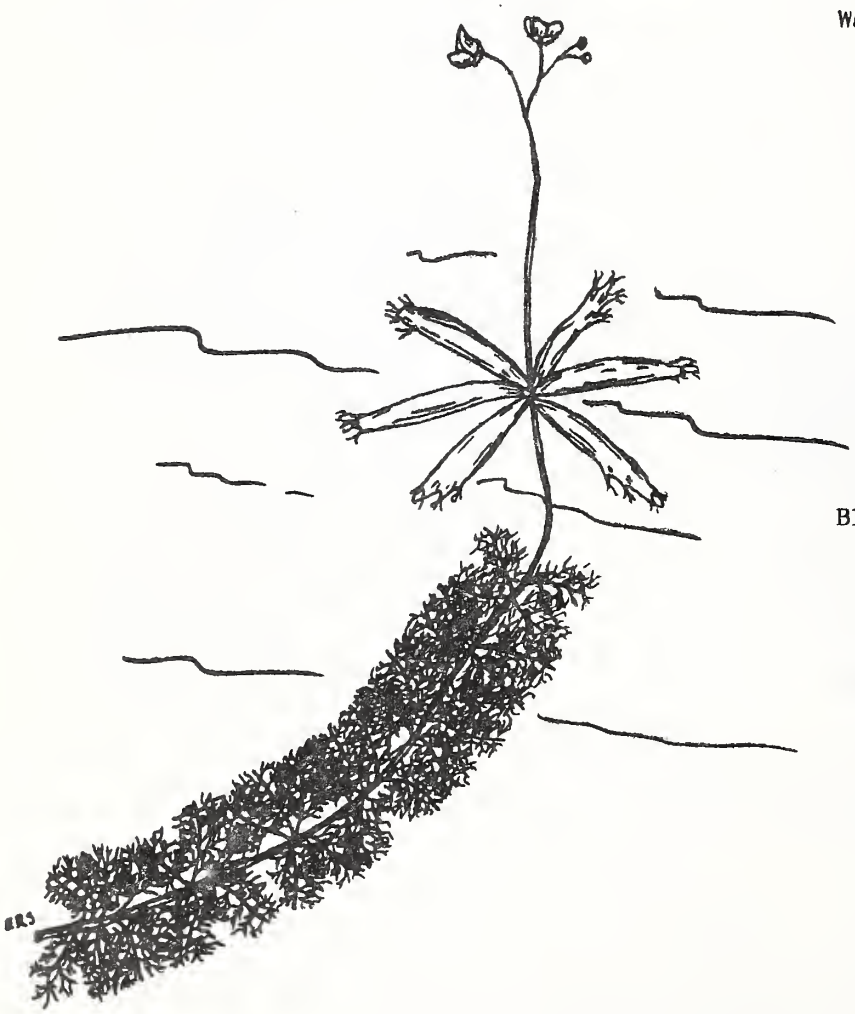

Water Primrose (Jussiaea) - Upper

A creeping plant found in the margins of ponds or lakes. The flowering stalks turn up and grow out of the water. The leaves along the prostrate stems are narrowly elliptical while those of the flowering section have much more rounded and broader tips. The flowers are large (about 1 inch across) and are varying shades of yellow. Frequently these plants will put out white "foamy" looking aquatic roots that lie near the surface.

Bladderwort (Utricularia) - Lower Left

This plant is generally free-floating, but occasionally rooted. The mainstem is thin and the leaves are irregularly spaced along it. The leaves are much divided and thread-like. Small black bladders are borne among the leaves and are distinctive enough for identification. The flowers are borne above the water and sometimes have floats at their base, depending on the species. The flowers are yellow or purple. Generally found in acid waters.

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Juncus repens

Leaves - A member of the rush family but with grasslike, short and recurving leaves, growing in tufts along the proliferating stems or runners. Light green in color.

Stems - Lax and creeping. Producing a new tuft of leaves (or plants) as it grows. Appear as a flat, black runner.

Flowers - Not usually encountered, but when they are, they are at or near the tips of upright stems. Rusty brown in color and elliptical in shape, they are found in dense heads.

Special Characteristics - When seen from above, this plant looks like a grass submerged.

Habitat - Shallow water.

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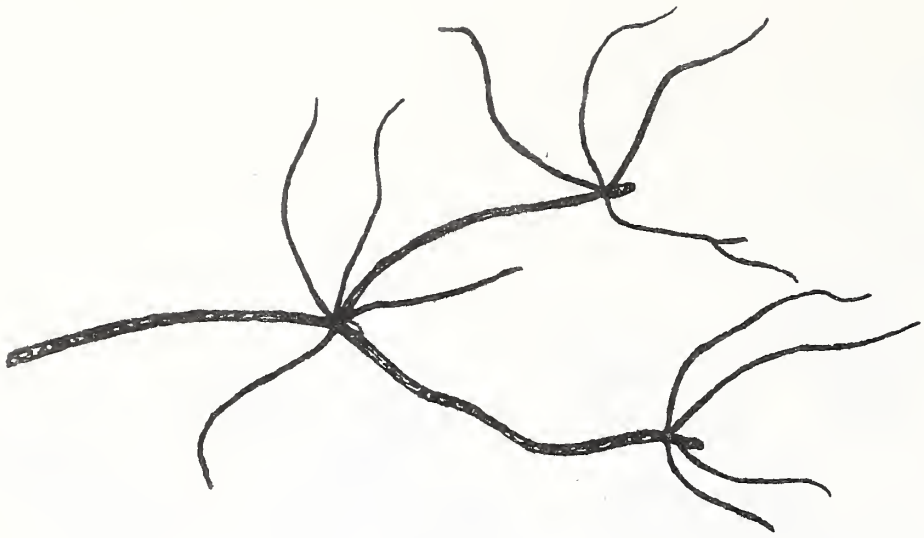
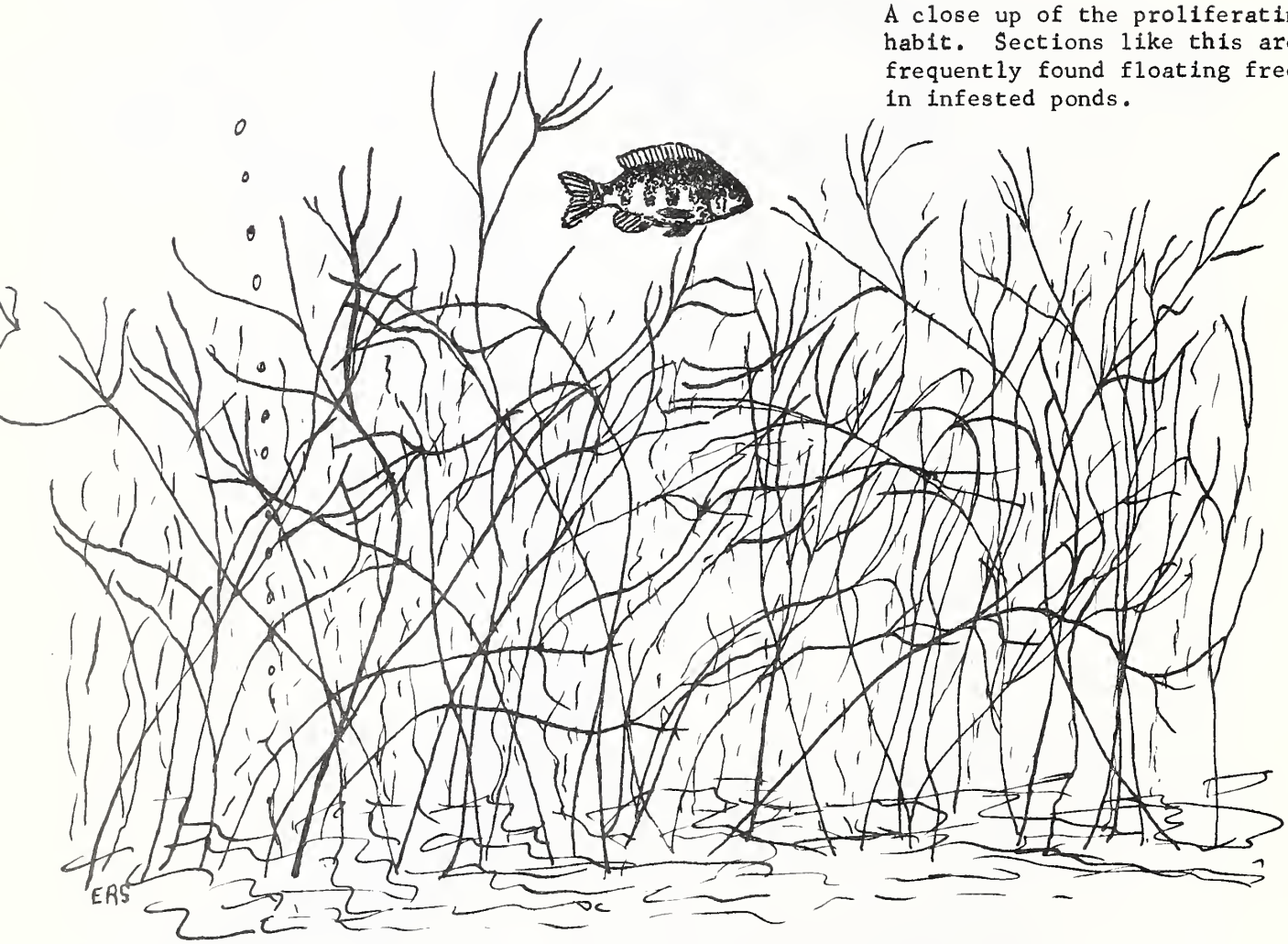


A close up of the proliferating habit. Sections like this are frequently found floating free in infested ponds.



Proliferating Spikerush (Eleoncharis)
Leaves - Cylindrical, dark green, and wiry.

Stems - Sometimes rooted, but may be free-floating. This plant, like Juncus repens, has a proliferating habit, where the stem or leaves may vegetatively produce new plants, until the plant is one great branching tangle. It is a difficult one to identify for the amateur since it doesn't resemble much of anything when taken from the water. When this plant is grown on land, it resembles any of the spikerushes.

Habitat - Shallow water.

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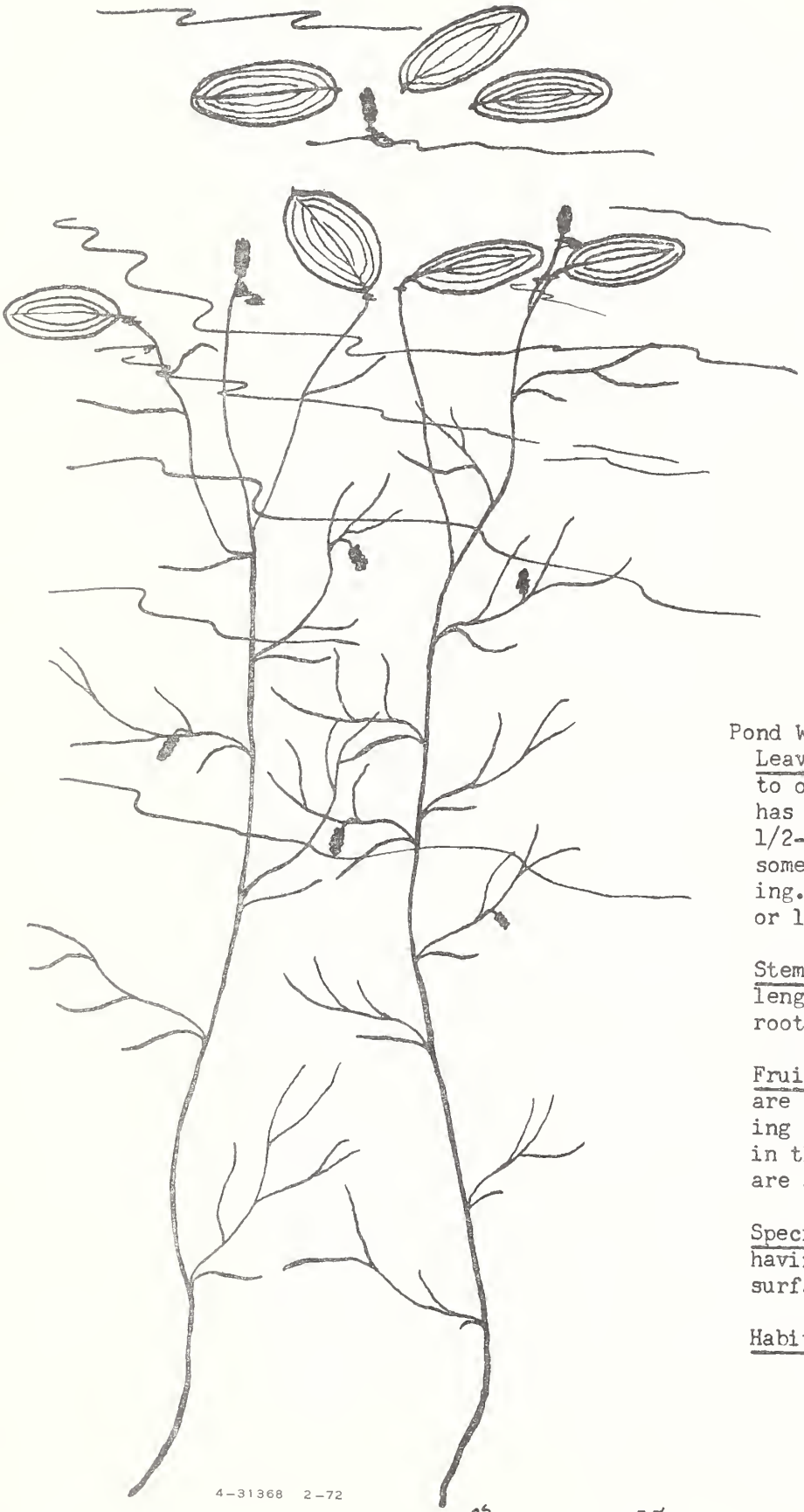

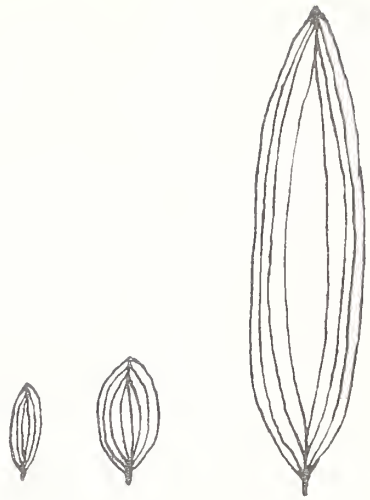

The variation of floating leaf size of species found in La.

Pond Weeds (Potamogeton)

Leaves - Upper floating ones elliptical to oval, generally small (one species has very large leaves 3-10 inches long) 1/2-2 inches. The surface is waxy. In some cases the upper leaves may be missing. Lower leaves very narrow 1-2 mm or less and strap-like.

Stems - Thin but strong, varying in length, according to water depth. Always rooted.

Fruit - The small cylindrical seed heads are on separate stalks, sometimes appearing above the water or generally found in the axil of the leaves. These seeds are avidly taken by ducks.

Special Characteristics - The only plant having leaves this small floating on the surface of the water.

Habitat - Any body of water.

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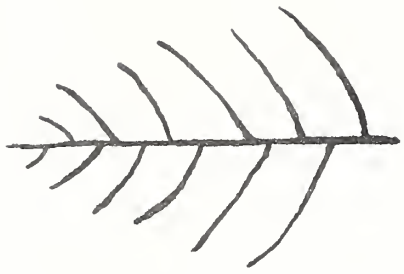
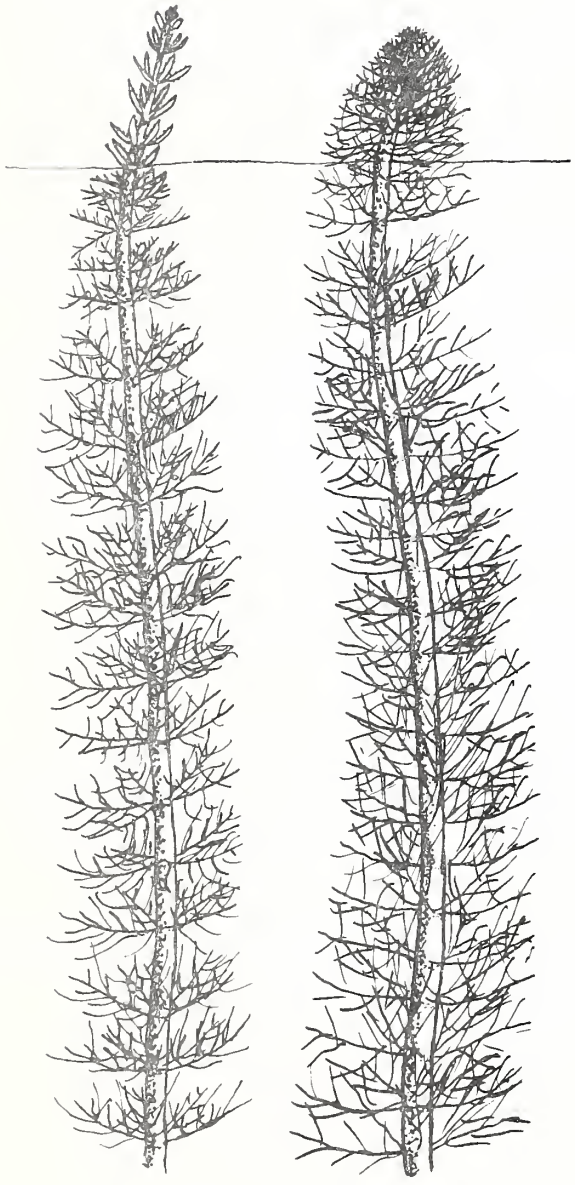
Parrots Feather aerial leaf

Water millfoil aerial leaf



Underwater leaf



Parrots Feather (Myriophyllum)

On the right--

Leaves Upper ones are short, finely divided, featherlike, bright light green, and crowded together near the tip. The lower submersed ones are much longer, finer, spaced further apart and are brownish in color.

Stem Thick and hollow, or loosely pith filled, and reddish-brown in color.

Special characteristics The thick stems and bright green aerial leaves are very distinctive.

Habitat Shallow water, but will grow as deep as five feet.

Water Milfoil (Myriophyllum)

On the left--

Leaves Upper ones are elliptical, with scalloped edges, giving them a prickly appearance, and dark green in color. The lower ones are the same as Parrots Feather, described above.

Stem Same as Parrots Feather.

Special characteristics The slender tip of this plant projects above the water, like a finger, which easily separates it from Parrots Feather. Without the aerial leaves these two are very difficult to separate.

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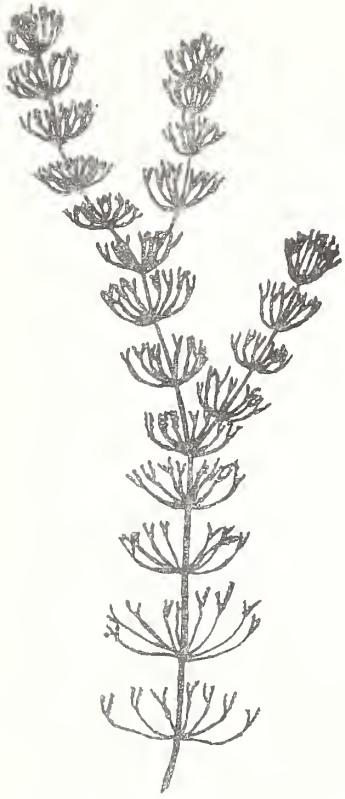

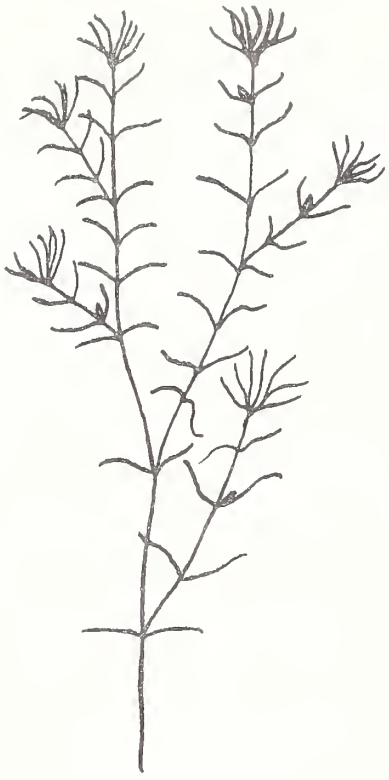

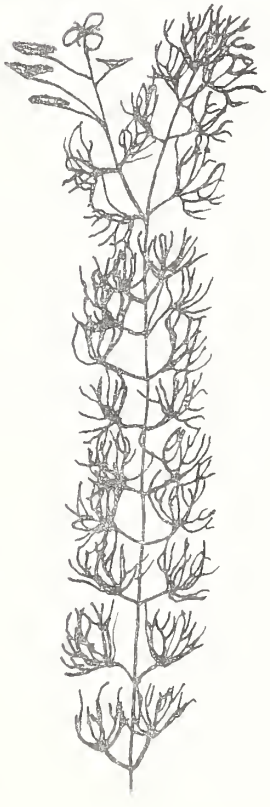

Coontail (Ceratophyllum) - Upper Left

A submerged brittle herb, with leaves in whorls about the main stem, which is generally forked once to several times. The leaves are very fine and forked (sometimes divided into 3's) at the tips. These "tiplets" have a "spiny" appearance because of their wavy margins. This plant is "rooted" in the spring and early summer and free-floating in the late summer and early fall. The seeds of this plant are taken by water fowl.

Naiads (Najas) - Upper Right

Submerged herbs with opposite or whorled, narrow to threadlike leaves. The bases of the leaves sheath the stem. The mainstem is branched and has fibrous roots. The seeds are small and elliptical and are found in the axil of the leaves. This plant is a favored food of many ducks.

Fanwort (Cabomba) - Lower Left

Delicate, branched, submerged herbs with finely divided leaves that are opposite or in whorls. Occasionally the upper floating leaves are produced. These are small, oblong, and attached at the center of the blade. The flowers are small and have three white to yellow petals.

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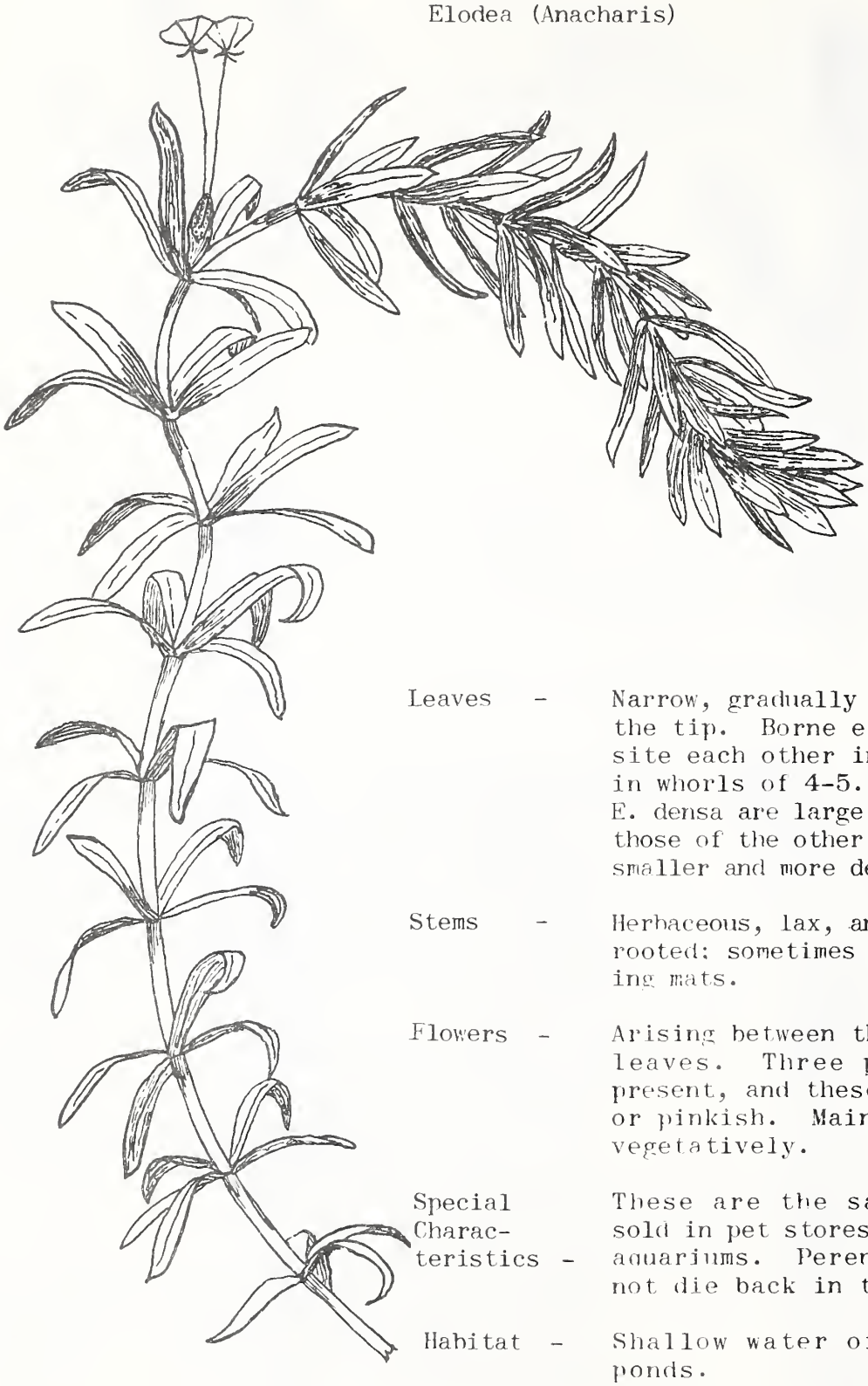
WATERWEED

Elodea (Anacharis)



Leaves	-	Narrow, gradually tapering to the tip. Borne either opposite each other in pairs, or in whorls of 4-5. Leaves of E. densa are large and coarse; those of the other two species smaller and more delicate.
Stems	-	Herbaceous, lax, and generally rooted: sometimes form floating mats.
Flowers	-	Arising between the stem and leaves. Three petals are present, and these are white or pinkish. Mainly spreads vegetatively.
Special Characteristics	-	These are the same plants sold in pet stores for use in aquariums. Perennial, does not die back in the winter.
Habitat	-	Shallow water of lakes or ponds.

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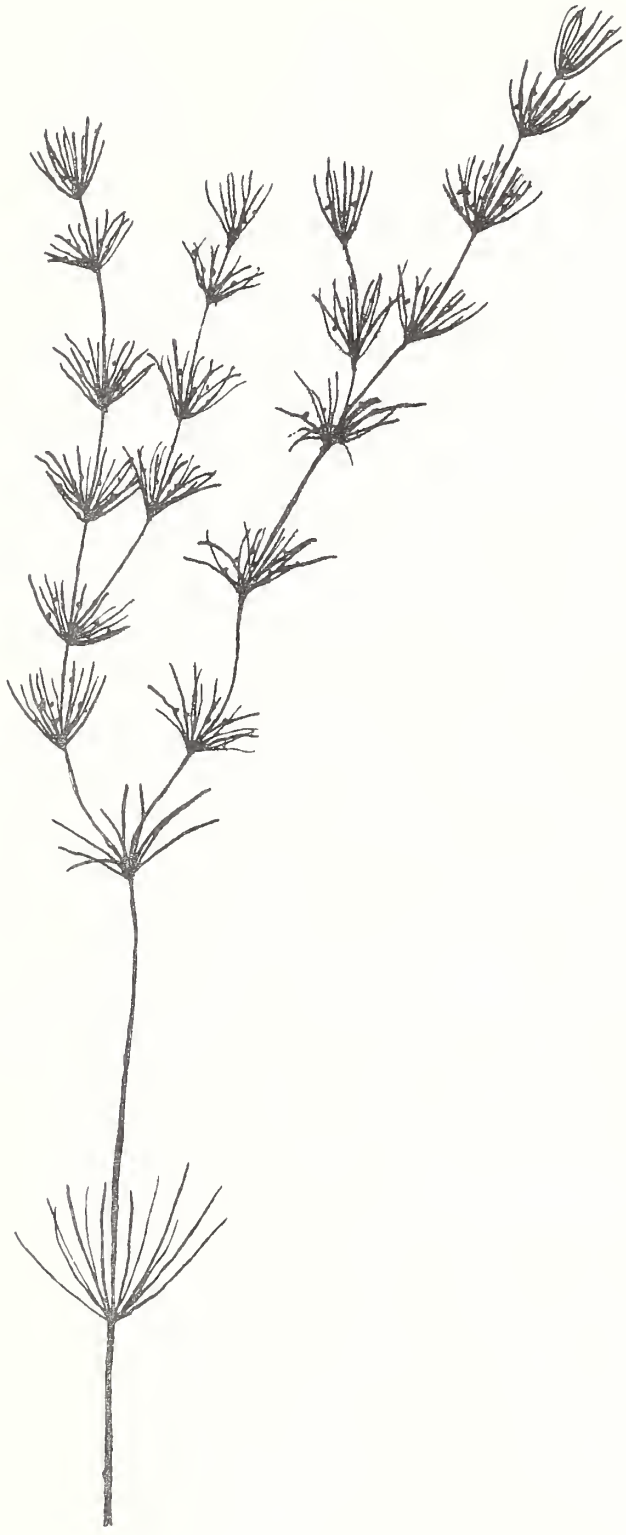

Stoneworts - Muskgrass (Chara)
Actually a higher form of perennial algae. The 6-12 leaves are cylindrical and arranged in whorls around the stems and branches. Stems, branches, and leaves are very brittle, and when crushed, emit a strong musk-like, or "skunky" odor. The "fruit" or oogonium appears as small black dots scattered over the leaves of the plant. Variable in height but generally not reaching the surface of the water. All parts of the plant are eaten by waterfowl.

ERS

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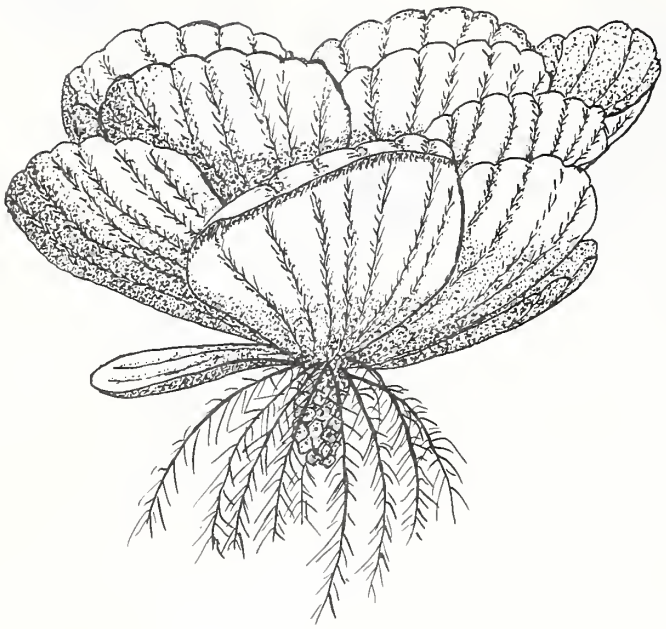

Water lettuce (Pistia) Free floating on bayous, canals and ponds in the southern part of the state. Looks very much like a "relaxed" head of lettuce with the leaves open and green all the way to the base. Leaves strongly ribbed and pubescent, gray-green in color and spongy feeling.

Water hyacinth (Eichhornia) Free floating or stranded:on rivers, ponds, bayous, swamps and marshes. Leaves glossy green and rounded to kidney shaped with inflated bases. A few to many leaves to the plant; frequently growing to the height of 18 to 24 in. high, usually lower. Flowers 6 petaled, whitish blue to purple. The uppermost darker with a yellowish teardrop shaped "eye." A few to many flowers per stalk.

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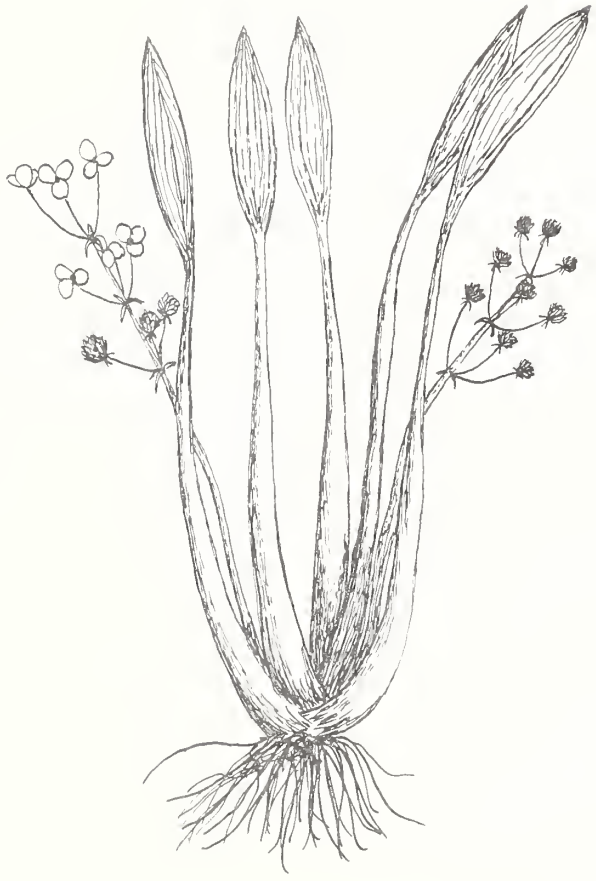
Waterleaf, Hydrolea - The only emergent aquatic plant with spines. These are found growing at the base of the leaves and generally there are two present. Leaves ellipical to oval and alternately spaced on the stem. Flower blue and seed pods round. Found growing in damp soil to shallow water.



Bulltongue, Sagittaria- stems clasping and thickest at the base: triangular in cross section leaves very narrowly to broadly lance shaped. Flowers small, white and 3 petaled. Three flowers to the whorl. Seed heads small and yellowish. This plant is in the same family as arrowhead but the leaves never have the arrowhead shape.

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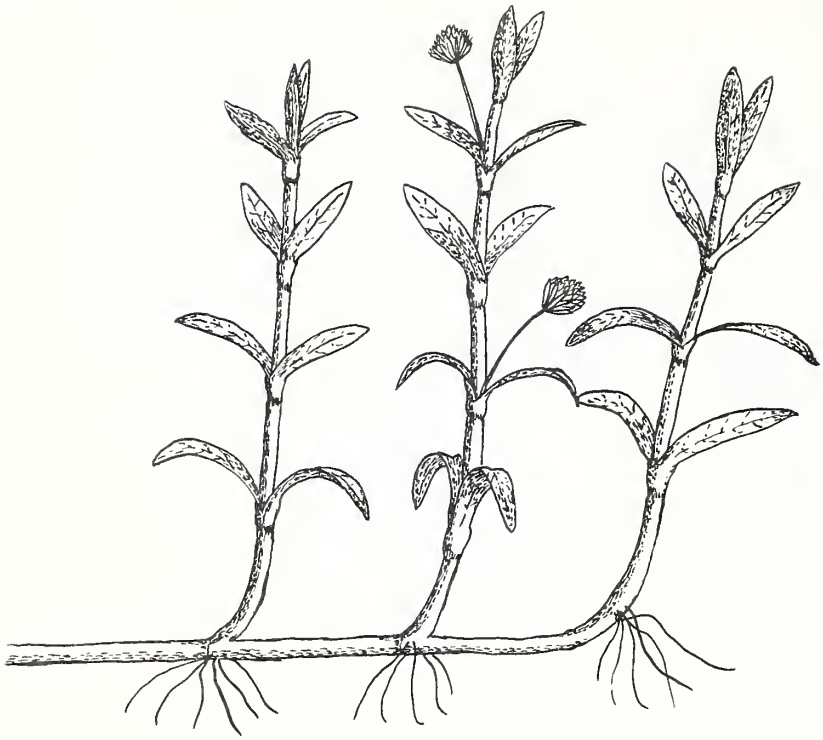

Alligatorweed (Alternanthera) May be found growing upright on damp soil or growing as a floating mat in water. Leaves roughly oval and opposite one another on the stem. The bases of the leaves merge to form a sheath which is slightly swollen. Leaves and stems succulent and fleshy. Flowers white and resemble the flowers of white clover. These are borne on a long stalk growing between the stem and leaf. Seeds are not viable and this plant reproduces vegetatively from the nodes.

Carolina watergrass (Hydrochloa)- leaves small, (1-2 in long x 1/4 in. wide) ellipical grayish green to green in color. These are found mainly towards the end of the stem and float on the surface. This plant can be found growing next to the shore or in shallow water. May form floating mats which can cover up small ponds. Rarely fruits.

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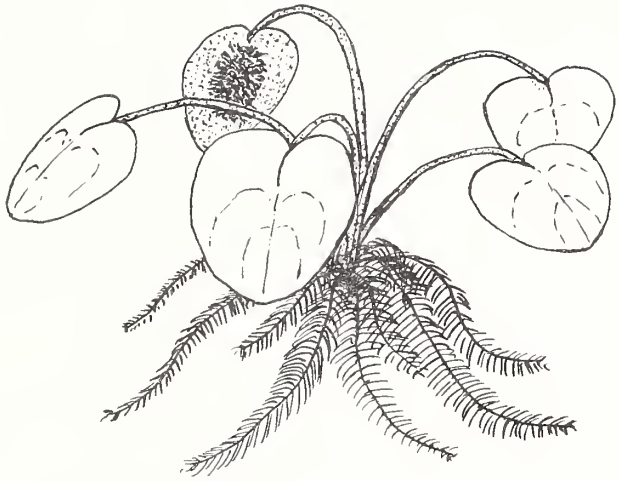

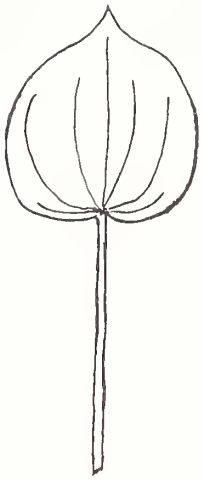

Frogbit Limnobium - found floating in shallow water or rooted in the mud. When rooted the leaves appear as those on the right without the deeply indented heart-shaped base. Flowers are small, white and star shaped. Roots may be found sprouting from the underside of the leaves when they come in contact with the water.

Giant-cutgrass - a very robust grass growing in clumps up to 6 ft. tall or taller. Leaves long and bearing spines or margins that can cut readily. Flower from February to August with the seed head a yellow-green in color and many times drooping. Grows from wet soil to shallow water.

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